DOCTOR OF PHILOSOPHY

A Mixed Method Investigation of the Factors that Influence Juror Interpretation of Forensic Science Testimony Presented for the Prosecution in Nine Homicide Trials in the United States

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Declaration of Original Work

Declaration by candidate: This thesis is a presentation of my original research work. I have consulted all references cited. Any contributions by others are noted, including collaborative discussion. This thesis contains no material that has been submitted previously, in whole or in part, for the award of any other academic degree or diploma. The author/researcher has no conflict of interest related to this investigation.

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As primary PhD supervisor for Researcher Wilcox, I certify that the above declaration is true to the best of my knowledge.

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Abstract

The judicial system calls upon expert witnesses to testify in court when complex or specialized knowledge, beyond that of the lay person, is needed to interpret the evidence. Expert witnesses explain the meaning of the evidence and can express their opinion of its significance within the context of the circumstances of a given case. In a jury trial, it is the responsibility of the jury to listen to, assimilate, comprehend and to place the appropriate weight on the expert testimony in their final decision making.

Knowledge of how juries comprehend forensic science evidence and how this type of testimony influences decision-making is sparse. The United States National Academy of Science report, "Strengthening Forensic Science in the United States: A Path Forward" (National Research Council, 2009) called upon the greater forensic science community to address weaknesses in the forensic science disciplines. One of the weaknesses highlighted was a lack of research into how juries use and comprehend forensic evidence.

This study aimed to investigate the perceptions jurors have of expert witness testimony, delivered as oral evidence, by prosecution forensic scientists in homicide cases in the United States. Data was gathered from juries after they had completed jury duty in one of nine homicide cases through both questionnaire (n=29) and direct one to one interviews (n=22). How jurors determined the credibility of an expert witness and their views of the reliability of evidence presented to them by the witnesses they were exposed to were explored. The importance of forensic evidence in the jury decision making process and the tensions between the expertise and experience of the witness were also explored together with jurors' view of technology and their

understanding of the science presented.

The role of the use of narrative in evidence was explored in particular through the use of demonstrative aids to explain the scientific evidence. Jurors described a deeper understanding as a result of such testimony. Jurors also suggested that the expert witness's education and years of experience were move favored over certification and laboratory accreditation and the credibility of the witness was reported to be a key factor in the juror's acceptance that the evidence presented was reliable. The results of this study underpin the importance of the role of the judge as a gate keeper to ensure only valid and reliable scientific evidence is admitted and presented to the jury in court. This work has also exposed the degree to which jurors evaluate the reliability of forensic science evidence based on the credibility of the expert witness.

Layout of the Thesis

Chapter 1 outlines the purpose of the research and states the research questions, hypothesis questions and gives an overview of the history of the expert witness. This chapter also contains a brief overview of the criminal trials that formed the basis of the expert testimony which was evaluated by the jurors and the range of previous juror and jury research is discussed.

Chapter 2 describes the mixed methods methodology and how the quantitative and qualitative data was collected and analyzed.

Chapter 3 introduces the three prominent models of juror decision-making and discusses how this research related to these three models.

Chapter 4 discusses how the jurors in this study viewed the credibility of the forensic science expert witnesses and how the jury determined the value of the forensic science evidenced they presented.

Chapter 5 outlines the current theories on how the deliberation process impacts jury decision-making and how the deliberation process influenced the jurors in this study. The chapter also discusses the jurors' perceptions of the attorneys, how the evidence was presented and the CSI effect.

Chapter 6 contains the overarching conclusions of this research.

Chapter 7 summarizes the conclusions and suggests recommendations based on these conclusions.

The appendices contain information on the homicide trials and the demographics of the jury which form the background to this study. A copy of the judicial order giving permission to carry out the research and copes of the survey and interview questions are also available in the appendices.

Glossary

Term	Definition
Complex DNA samples	Samples which contain the DNA profiles of three or more individuals
Expert Witness	An individual, deemed by the judge, to have specialized knowledge, skill or experience, who's testimony can help the jurors understand a fact in the case
Feature Comparison Sciences	A subsection of forensic evidence which involves the comparison of the physical characteristics of an item recovered from a crime scene/victim to those of a known source. E.g. bullet, footwear, tiremark etc.
Forensic Science Evidence	Hypothesis based evaluative opinion relating to the presence of materials and items at crimes scenes or associated with victims. Considered in light or both a prosecution and defense hypotheses. Also used to generically describe the specific materials and items being considered e.g. firearms, shoeprints, DNA etc.
Foundational validity	Demonstrating that a scientific process is valid in terms of its precision (repeatability and reproducibility) and accuracy.
Validity as applied	The demonstration through accredited processes that valid techniques are applied appropriately to casework samples
Gate keeper	The judge in his/her role to ensure only reliable evidence is admitted into court
Lay witness	An individual who testifies in court, and is not an expert or a professional (police/fire service etc.) witness
Mock Jurors	Individuals who are asked questions in simulated court room exercises for research purposes, but whose answers are not based on real jury experience
Nunchucks	A martial arts weapon which consist of two short bars connected by a short chain
Police Witness	A law enforcement officer who testifies in court
Public Defender	A lawyer for the defendant who is appointed by the State when the defendant cannot retain their own lawyer due to financial reasons
Voir Dire	A process of asking jurors questions prior to trial to establish their viability to be impartial. It can also be applied to assess the admissibility of evidence during a trial.

CHAPTER 1: The Nature of the Study

1.1 Introduction and background to the study

The right of the accused to a trial by jury can be traced back to King John's Magna Carta in 1215. The Magna Carta, meaning the 'Great Charter', was a document outlining the rights and liberties of "freemen" in England and in particular stated that everyone was subject to the law, including the king. The original version of the Magna Carta had 63 clauses and all but three of them have been repealed (Breay and Harrison, 2016). The Magna Carta is most famous for the 39th clause which states,

> *"No free man shall be seized or imprisoned, or stripped of his rights or possessions, or outlawed or exiled, or deprived of his standing in any other way, nor will we proceed with force against him, or send others to do so, except by the lawful judgement of his equals or by the law of the land. To no one will we sell, to no one deny or delay right or justice (Magna Carta, 1215)".*

This clause of the Magna Carta is echoed in the U.S. Bill of Rights (1791) as well as in the Universal Declaration of Human Rights (1948) and in the European Convention of Human Rights (1950) (Breay and Harrison, 2016) . The Magna Carta established a fundamental human right to a trial before conviction and left the decision making for guilt or innocence in the hands of the accused's "peers" in the form of a jury (Holt et al., 2015, Linebaugh, 2008).

Eighteenth century Americans saw the right to a jury trial as a hallmark of a free society (Hazeltine, 1917). Within the United States, the right to a jury trial is protected by the Constitution which states that, "The trial of all crimes, except in cases of

impeachment, shall be by jury; and such trial shall be held in the State where the said crimes shall have been committed" (U.S. Const. art. III, § 2). The right to a jury trial can also be found in the United States Bill of Rights. "In all criminal prosecutions, the accused shall enjoy the right to a speedy and public trial, by an impartial jury of the State and district wherein the crime shall have been committed" (U.S. Const. amend. VI). A key word in this Amendment is impartial.

The interpretation of the term "impartial" has given rise to a process, where jurors who have a connection to the defendant, the victim, the witnesses or who have personal knowledge that may unduly influence jury deliberations, are not selected to sit on a jury.

This process to determine impartiality, known as *Voir Dire,* is directly related to the need for witnesses to familiarize the jury with the circumstances of the case and in turn for the jury to arrive at a verdict. When a case contains complex or scientific evidence, expert witnesses are often called to testify to assist the jury with their understanding of the evidence.

Expert witnesses can be any person with specialized knowledge who can assist the trier of fact (the juror) understand the evidence. For example, engineers may be called to explain the circumstances that lead to a bridge failure, doctors may be called to explain how particular symptoms are indicative of disease, and psychiatrists may testify about the mental state of the defendant at the time a crime was committed and so on. In many criminal cases forensic scientists are now called to testify about evidence recovered at a crime scene or which has arisen from law enforcement enquiries and which may or may not suggest a link between a defendant and an alleged offence.

Unlike lay witnesses and police witnesses who testify to direct evidence only, expert witnesses are allowed to make inferences and give their opinion to the Court. The ability to express an opinion makes the role of the expert witness a very powerful one in the trial process (Garrett and Neufeld, 2009, Eastwood and Caldwell, 2015). It is clear that the role of an expert witness is essential to the jury in understanding evidence which is specialized and outside the knowledge base of the average juror. Most jurisdictions in the United States do not allow the jurors ask questions of the expert witnesses (Diamond et al., 2006). The question remains then, how does the expert witness know when they have sufficiently explained the evidence to the jury to aid in their understanding?

With the increased use of forensic science evidence in criminal courts over the past 20 years there has been increased desire by the judicial system to gain a better understanding of how jurors interpret scientific evidence (Schweitzer, 2016). This was previously highlighted by the United States National Academy of Science, National Research Council report "Strengthening Forensic Science in the United States: A Path Forward (2009)" when they reported;

> *"Jurors' use and comprehension of forensic evidence is not well studied. Better understanding is needed in this area, and recommendations are need for … methods that will better prepare juries… for trials in which scientific testimony is expected to play a large or pivotal role" (National Research Council, 2009)".*

The Department of Justice (DOJ) in partnership with the National Institute of Standards and Technology (NIST) finally established the National Commission of Forensic Sciences (NCFS) in 2013, four years after the publication of the National Academy of Science (NAS) had recommended it, with a remit to address some of the recommendations from

the report (Department of Justice, 2013). The DOJ listed a primary goal of the NCFS as "developing proposed guidance concerning the intersection of forensic science and the courtroom".

In early 2014 the DOJ and National Institute of Standards and Technology (NIST) launched the Organization of Scientific Area Committees (OSAC). These committees comprising over 600 subject matter experts with a remit to develop standards of practice with a long term objective to set guidelines for forensic scientists' certification as well as laboratory accreditation. The NCFS and the OSACs are important bodies who have started the process of setting standards in forensic science.

The issue of scientific validity and reliability under-pinning the forensics sciences was a core concern outlined in the NAS report. In 2015 NIST announced that Iowa State University would lead a Center of Excellence to improve statistical analysis in forensic science (CSAFE). The focus of the center is "on improving the statistical foundation for fingerprint, firearm, toolmark, dental and other pattern evidence analyses, and for computer, video, audio and other digital evidence analyses (Newman, 2015)". This will begin the process of addressing the core criticisms of the NAS report. In September 2016 the President's Council of Advisors on Science and Technology (PCAST) published a report titled "Forensic Science in Criminal Courts: Ensuring Scientific Validity of Feature-Comparison Methods" which criticized forensic science feature comparison disciplines, such as bullet identifications, footwear comparisons and interpretation of complex DNA samples where material from three or more individuals may be present (Holdren et al., 2016). These disciplines rely on a comparison process where the forensic scientist makes conclusions based on subjective (rather than empirical) criteria. The PCAST report

highlighted the urgent need for empirical research into the foundational validity of the feature comparison sciences. Research to address foundational validity is needed to ensure the testimony of forensic scientists is reliable and in turn allow the courts to have confidence in expert testimony.

As the forensic science community continue to take steps recommend by the NAS report, to standardize training, qualifications, conclusions and engage in more fundamental research, it is essential that the expert witness and juror relationship not be forgotten. It is still unclear whether or not jurors understand the forensic science evidence presented to them during a trial and how they place weight on such evidence during their decision-making processes. The purpose of this research was to gain a better understanding of how jurors interpret evidence presented to them from across a range of forensic science disciplines.

1.2 Research Questions and Hypotheses

The overarching aim of this research was to investigate the factors which impact juror decision making and their understanding of scientific facts and opinions expressed by the prosecution forensic science expert witnesses they observed during homicide trials. This aim was addressed by the following four specific research questions and two hypotheses.

Research Question 1 (RQ1): How do jurors assimilate forensic science evidence into the other narrative information associated with the trial and how does this influence their decision making?

The literature suggests that there are three different theories which explain how jurors' process and place value on information; 1) through central and peripheral processing of information, 2) based on the story model, and 3) by following the strength of the evidence.

Research Question 2 (RQ2): Do jurors correctly understand the testimony of the forensic scientist and do they place the appropriate weight on the evidence given the testimony?

Research Question 3 (RQ3): What factors cause jurors difficulty with understanding the forensic science evidence?

Research Question 4 (RQ4): What factors influence how jurors judge the credibility of forensic science experts and the reliability of forensic science evidence?

Hypothesis 1 (H1): Jurors view training and experience of the expert forensic witness to be more important in determining credibility than the certifications he/she has earned and if the laboratory he/she works in is accredited.

Hypothesis 2 (H2): The juror's view of the credibility of the forensic scientist influences the juror's view of the reliability the forensic evidence.

A parallel convergent exploratory mixed methods design was used to approach these research questions and to facilitate a deeper understanding of the influence forensic science testimony has on real jurors. This mixed methods approach also was used to explore to what extent, and in what ways qualitative interviews with jurors serve to explain the quantitative data collected in respect to the factors that influence jurors' interpretation of forensic testimony.

1.3 The Nature of the Study

Earlier research into factors which influence juror decision making falls into three broad categories: 1) data collected by survey (Kalven et al., 1966), 2) data collected by listening to jury deliberations (Hannaford et al., 2000, Hans et al., 1998) or reading notes taken by jurors during the trial (Myers, 1979, Diamond et al., 2003) or 3) data collected by interviewing mock and real jurors (Ellison and Munro, 2010, Ryan et al., 1987, Saks and Wissler, 1984). Mock jurors are individuals who meet the criteria necessary to serve as a juror but have not acted as a juror in an official capacity. The vast majority of our knowledge of juror and jury decision making comes from surveys of mock jurors, and to a lesser extent surveys of real jurors.

Understanding the factors that influence real jurors' decision making, with a specific focus on forensic science evidence, was an important feature of this research. In order to gain a deep understanding of how jurors interpreted and used forensic science evidence, in their decision making, this study followed a mixed methods approach where both quantitative and qualitative data were collected via a survey mailed to jurors (n=29) and additional, more in- depth qualitative data were collected during phone interviews with a sub-group of the jurors who completed the questionnaires (n=22). While it is recognized that the number of participants within this study is small, this is not unusual for direct juror interview studies where access can be very limited. The depth and richness of information, in particular arising from the in-depth interviews, enriches our understanding of how the jurors acquire their knowledge base.

1.4 The History and Background of Juries and Expert Witnesses

1.4.1 History and Origin of the Scientific Expert Witness

Expert witnesses, as we know them today, were not always a feature of the Anglo/American criminal justice system. A series of shifts in court needs and processes from medieval times in England to trials today in the United States has helped establish the role of the expert witness in U.S. courts (Stygall, 2001). Before trials by jury, crimes were solved by combat, ordeals (physical tests) and by oath. These methods of determining the truth were thought to be controlled by divine intervention (Landsman, 1995).

In twelfth century England the court system was decentralized and disputes and crimes were heard in the estates and manors where the crime arose. During the reign of Henry II, the Curis Regis (King's Court) was established and thus began the process of centralization of the criminal courts. This era saw a move away from "free men settling disputes themselves" to the State emerging as the chief prosecutor (Jones, 1994). The king's court had a vested interest in investigating the cause of death of persons who may have committed suicide or felonies as the king had the authority to take possession of the estates of the decedent/perpetrator.

The first juries in medieval England were self-informing and were selected as they had personal knowledge of the facts of the case and often knew the defendant, "they were witnesses and investigators" (Jones, 1994). If there was a special need for an expert to understand the facts of the case the jury would be selected to accommodate this need. Records show that the first early experts to be part of juries were medical professionals.

In cases of rape and child abuse, doctors were empaneled as part of the jury. Midwives made up a jury in a case where inheritance was in question. For example, one record illustrated that when a woman gave birth 40 weeks and nine days after the death of her husband, the jury (containing midwives) sided with the woman and her son (rather than the late husband's family) gained the inheritance. Women were considered experts on the female body (Jones, 1994, Hand, 1901, De Renzi, 2007). Another record shows that when a female prisoner was waiting a death sentence a jury of midwives were called to determine if she "was with child" and if the sentence should be postponed (Vidmar and Hans, 2007). In trade disputes (which were common) particular skilled tradesmen; fishmongers, bridge engineers or other trades men would be called to sit on juries when specialized knowledge was needed (Vidmar and Hans, 2007).

At the same time as trials were calling specialists to sit on juries, the medical profession in Great Britain and on Continental Europe was becoming more formalized. This professionalism led to an increase in skilled juries being used to preside over trials as outlined in fourteenth century records from the Old Bailey (Hand, 1901).

A landmark case set in motion a move away from the self-informing jury to the "passive pre-adversarial jury" (Landsman, 1995). In 1670, the *Bushell's Case* concerned a charge against two Quakers (who were an unpopular group at the time) for illegal assembly. The jury returned a verdict of not guilty. The judge did not agree with the verdict and the jury was locked up for three days without food, heat or water (Hand, 1901). In this case the jury had more knowledge of the circumstances of the case and the judge's understanding was incomplete which was problematic given the responsibility for the case rested with the judge. This case catalyzed a movement away from the

knowledgeable jury to more passive jury for the purpose of judicial control over verdicts.

During the sixteenth century, judges called advisors or experts when matters of fact in a case needed to be explained or clarified. These court advisees were for the sole purpose of the judge and advice was given in private and was not subject to cross examination (Jones, 1994). Reports show that judges felt compelled to take the advice of the specialized advisors and the critics at the time felt the role of the court expert was over influencing the judge's decision making power (Jones, 1994). Scientific advisors were being relied upon in a high percentage of Patent and Admiralty (maritime) courts and judges were losing credibility as a consequence. Some disputes began to be heard in special arbitration courts to avoid the perceived monopoly of the court advisor (Jones, 1994, Mnookin, 2007).

In an effort to improve their credibility, some judges took courses to help in their understanding of the expert evidence (Jones, 1994, Forsyth, 1929). Records show that one seventeenth century judge in Italy, in an attempt to judge a poisoning case, asked that a dog be fed the victim's vomit and a notary was to record the symptoms. The judge (like many at the time) was frustrated with how physicians favored natural causes of death over poisoning. He hoped that carrying out this experiment would teach judges to examine the evidence for themselves. The expert physician in the case argued that poisoning and other causes of death could not be brought down to a simple observable test and the case needed to be examined holistically and by a trained medical professional (De Renzi, 2007). This case highlights the struggle between the need for expert guidance and the judge's desire for control of testimony and verdicts in the court at that time

Through the eighteenth century the trial process had become much more adversarial and both parties (prosecution and defense) took part in questioning court appointed experts. This gave rise to the birth of the modern expert witness (Landsman, 1995). In 1782 the case of *Folks v. Chadd* set the stage for the modern system of expert witnesses being called as part of the adversarial process. In this civil case damages were being claimed as a suggestion that the erection of a bank in a harbor had caused silting in the harbor which had effected nearby businesses. The defense attorney called an engineer named Mr. Smeaton as a defense expert who testified that similar banks, built in nearby harbors, did not cause silting. His opinion was that the building of the bank did not cause the silting. There were objections from opposing counsel that the testimony was on an opinion and that the jury should base it verdict only on facts and not opinion. The judge disagreed and stated that Mr. Smeaton's "judgment formed on facts, was very proper evidence" (Jones, 1994).

For the next few hundred years' experts were allowed to give their opinion but not draw conclusions, as this was considered the role of the jury. This led attorneys to begin to use hypothetical questions to skirt around the rule and have an expert give a conclusion to a hypothetical question (Mnookin, 2007). Often the resultant questions contained such a long narrative that judges felt the attorney had taken the place of the expert. Experts were often only asked to answer 'yes' or 'no' to these multifaceted questions. The purpose of calling an expert was to present the facts of the case in a clear manner for the judge to interpret, however the usurping of the process through the use of convoluted hypothetical questions caused disillusionment in both the process and the experts (Mnookin, 2007, Erlander, 1970).

In the late nineteenth century there was a growing desire to discover ways to prove matters with certainty (Jones, 1994, Saks and Wissler, 1984). Many individuals who were close to the issue under scrutiny (the alleged crime) were not allowed testify. Atheists or others who refused to take the oath, plaintiffs in civil suits who would benefit financially from a settlement or defendants in criminal cases were not allowed to take the stand. The testimony of these individuals was considered tainted due to their close connection to the case and their perceived likelihood to give false testimony on the witness stand. The rules excluding these types of witnesses (atheists, plaintiffs and defendants) were abolished in Great Britain in 1843 and in the United States in Michigan in 1846. This led to an increased fear of witnesses perjuring themselves and created a strong desire for more objective scientific testimony (Mnookin, 2007).

1.4.2 Early American Expert Witnesses

In the late 19th century the courts in the United States reinvented the English system of court appointed experts and the adversarial process of each side calling their own expert. Judges wanted to get at the heart of the matter and to the facts of the case and became disillusioned by experts with strong credentials disagreeing on simple matters of fact (Jones, 1994).

By 1920 science in the United States was held in high esteem and from a court perspective "scientists were seen as particularly suited to mediate between conflicting parties" (Jones, 1994). The United States judicial system viewed the expert witness as fallible where the adversarial system of both sides calling their own expert was viewed as a more democratic process (Jones, 1994, Forsyth, 1929). However, at this time, the system of calling upon expert witnesses for each side (prosecution and

defense) was perceived as having two flaws, bribery and flattery. Expert witnesses were paid and were called to the witness stand by the party that hired and paid them and flattery was apparent when the expert was held to high esteem to "speak for the evidence" (Meier, 1986). Although the United States was quick to adopt the adversarial model of expert testimony this model "surrounded expert evidence with procedural requirements" in the form of admissibility standards (Jones, 1994).

1.4.3 History of Expert Witness Admissibility in the United States

From 1850 until 1920 the standard of admissibility for expert witnesses remained static. The court allowed an expert to testify if he had a skill or knowledge that he claimed to have. In 1923 Frye v. United States (Frye v. United States, 293 F. 1013 (Court of Appeals, Dist. of Columbia 1923)) set the stage for a series of expert admissibility standards (Landsman, 1995, McAuliff and Groscup, 2009). Frye's counsel had hired an expert to present evidence that the systolic heart rate of a suspect recorded during a polygraph test indicated he was innocent. The trial judge did not allow the testimony and the case went to the circuit court on appeal. The circuit court decided that expert testimony could only be presented at trial if the science was generally accepted in the relevant scientific community.

This case proved to be a significant milestone in establishing an admissibility standard for expert evidence even though Frye was not referenced in the ten years after 1923 and very few times over the subsequent twenty five years (Meier, 1986). In 1975 the Federal Rule of Evidence 702 (FRE 702) was adopted across the U.S. This gave judges in federal courts guidelines on how to test expert witnesses in relation to their credentials. According to FRE 702 a witness who qualified as an expert by knowledge,

skill, experience, training, or education was allowed to testify and provide an opinion or otherwise if:

1) the expert's scientific, technical, or other specialized knowledge will help the trier of fact to understand the evidence or to determine a fact in issue;

2) the testimony is based on sufficient facts or data;

3) the testimony is the product of reliable principles and methods; and

4) the expert has reliably applied the principles and methods to the facts of the case

5) the testimony was accepted by the relevant scientific community

(Graham, 1986).

In the 1970's U.S. courts were overrun with medical malpractice cases. This led to an increase in the use of scientific experts because tort law required a "physician's statement of deviation and negligence" (Weintraub, 1999). Expert testimony in medical malpractice cases began taking up a large portion of court time. Judges were frustrated when doctors, called by opposing sides, who had an established credibility continued to disagree when giving evidence (Mnookin, 2007, Hand, 1901). In an effort to be more efficient the ninth circuit court set forth a set of evidential admissibility requirements which became known as the Daubert admissibility requirements.

The case of *Daubert v. Merrill Dow Pharmaceuticals* went to trial in 1993 (Daubert v. Merrill Dow Pharmaceuticals, Supreme Court. 509: 593). The Dauberts were suing Merrill Dow Pharmaceuticals for birth defects in their child. They had hired a scientist who was willing to testify that a drug taken during pregnancy caused the birth defect. The challenge for the judge was to determine the validity and reliability of the science

before allowing the expert witness to testify. On appeal the US Supreme Court set forth a series of general factors that judges should use to assess whether to admit expert testimony (Bernstein and Jackson, 2004). The Daubert criteria are:

(1) whether the theory or technique can be or has been tested;

(2) whether the theory or technique has been subjected to peer review and publication, as such review "increases the likelihood that substantive flaws in the methodology will be detected";

(3) in the case of the particular technique, the known or potential rate of error;

(4) whether the theory or technique enjoys general acceptance within the relevant scientific community (Daubert v. Merrill Dow Pharmaceuticals, Supreme Court. 509: 593).

This case created a significant responsibility for judges above that of the Frye test as it placed the responsibility for assessing real science directly onto the judge whereas the Frye test left it to the judge to determine if the relevant scientific community accepted the science (Bernstein, 2007).

In 1997 the Supreme Court ruled in the case of *General Electric Company v. Joiner* that the court could examine the expert's conclusions as well as the scientific methodology and that judges needed to make sure that there was not "too great an analytical gap between the methodology and the opinion proffered" (1997). (General Electric Co. v. Joiner, Supreme Court. 522: 136). In 1999 the Supreme heard a third case which extended the Daubert criteria of admissibility to expert testimony beyond just science in the case of Kumho Tire v. Carmichael (Kumho Tire v. Carmichael, Supreme Court. 526: 137). The Supreme Court stated that the test for admissibility of expert

evidence applied to scientific, technical and other specialized knowledge. The Court also made it clear that the Daubert criteria were not a definitive checklist or test and the final decision on expert witness admissibility rested with the judge (Bernstein and Jackson, 2004).

Since the Daubert trial in 1993, judges in jurisdictions across the United States have struggled to determine when to allow science into the courtroom and when to prevent expert testimony. During the same period of time, research on the reliability of science within the forensic disciplines has been conducted to answer the questions that were put forth by the Daubert standards. This research has focused primarily on error rates mainly within the disciplines which have a robust scientific foundation (such as DNA, drug analysis or toxicology) (Saks and Koehler, 1991, Saks and Koehler, 2005). More recent research has focused on how bias influences conclusions of forensic scientists. Contextual bias, where the scientist knows information about the case, has been suggested to cause some forensic scientists to come to different conclusions (Dror et al., 2012, Budowle et al., 2009, Dror et al., 2006, Langenburg et al., 2009) however much of the published work makes use of only small sample numbers with often poor methodology.

Critics argue that judges are not qualified to determine the reliability of scientific testing (Wissler et al., 2013, Williams and Saks, 2015, Welner et al., 2012). Judges may have a basic understanding of science and may struggle in identifying what is required to determine the reliability of evidence. This may allow both poor quality evidence be admitted before the jury and good quality scientific evidence being refused (Mnookin, 2007, Klien et al., 2007, Hans, 2007, Vidmar, 2011).

In an environment where new research shows strengths and weaknesses in the forensic science disciplines, the gate keeping role of the judge is increasingly challenging (Ulery et al., 2011, Ulery et al., 2012). Judge Gertner described the difficulty he experienced in evaluating the admissibility of toolmark evidence. He felt the evidence did not meet the standards of reliability but given the long history of acceptance of toolmark evidence by the court, his decision to prevent the testimony being presented at the trial would be over turned on appeal;

> *"I reluctantly [admit the evidence] because of my confidence that any other decision will be rejected by appellate courts, in light of precedents across the country, regardless of the findings I have made…The more courts admit this type of toolmark evidence without requiring documentation, proficiency testing, or evidence of reliability, the more sloppy practices will endure; we should require more." - Judge Gertner in United States v. Green, 405 F. Supp. 3d at 107-08.*

The forensic science community is slowly addressing the lack of research on the scientific validity and consistency of conclusions in some of the forensic science disciplines (Ulery et al., 2011, Grieve et al., 2014, Macziewski et al., 2017, Haned et al., 2015, Duffy et al., 2010, Raymond and Sheldon, 2015). The NAS and PCAST reports have highlighted a need for ongoing research into forensic science validity and the forensic science community has and should continue to publish research on the strengths and limitations of these disciplines.

1.4.4 Early Juries in the United States

The colonists who settled in the new America (1492-1763) used the Common Law traditions from England to establish the new legal code. Charters from King James I specified that the colonies needed to develop laws, and that these laws would be consistent with English law (Kalven et al., 1966). The acts of these early communities have played a significant role in how the U.S. jury system works today. In the early

colonial years, trials without juries were the norm (Frankfurter, 1929). A charter to the Virginia Company in 1606 provided for trial by jury and by 1624 jury trials were available for all civil and criminal cases. Colonial juries were comprised only of men and only those who were considered freemen, not slaves. Jury service was a significant hardship on individuals. Jurors sat on many trials over series of days and accommodation expenses were the responsibility of the juror. When jurors did not show up for trial, which happened often, individuals from the street were conscripted. These individuals were known as 'telesman' and often considered incompetent (Vidmar and Hans, 2007, Forsyth, 1929).

During colonial times, judges did not give legal instructions to juries. It was believed that common law was based on natural justice and that it was intuitive. The jury at that time held significant power in the community. Colonists, with a view to making the laws in America fairer, relied heavily on juries to make important decisions. It was felt that juries would limit governmental corruption. Few important decisions were made without jury involvement, but jury nullification (when the prosecution has met its burden of proof but the jury acquits the defendant) was common (Vidmar and Hans, 2007, Hans et al., 1986, Abramson, 1994).

1.4.5 Modern Juries in the United States

After independence from England in 1776 the United States developed Constitutions that provided the right to a jury in criminal and civil trials. The United States Constitution states, *"The Trial of all Crimes, except in Cases of Impeachment, shall be by Jury; and such Trial shall be held in the State where the said Crimes shall have been*

committed" (U.S. Const. art. III, § 2). The right to a jury trial can also be found in the Bill of Rights. *"In all criminal prosecutions, the accused shall enjoy the right to a speedy and public trial, by an impartial jury of the State and district wherein the crime shall have been committed"* (U.S. Const. amend. VI).

The jurors represent the community in the courtroom and are responsible for coming to a verdict consistent with community values and norms at that time (Appleman, 2009). In cases where a prosecutor proves the defendant guilty beyond a reasonable doubt, the jury may still acquit the defendant. This is known as jury nullification.

On the other hand, the jury is seen as a protection from the government for the accused at trial. This is particularly clear in the sixth Amendment to the Constitution where the right to a trial by an impartial jury is granted to defendants (U.S. Const. amend. VI). The predominant perspective of the modern day jury is that the defendant has the right to a jury of his or her peers (Appleman, 2009). The adversarial process of *voir dire* (the system of interviewing individuals to determine their ability to sit on a particular jury) allows the prosecution and defense teams the opportunity to shape the jury by giving both sides in the adversarial process a chance to eliminate and select jury participants.

1.4.6 The Process of being declared an Expert Witness

In the State of Maine, like many other states in the United States, expert witnesses can be called to testify by either the prosecution or the defense. Expert witnesses speak for the evidence and explain its meaning for the jury (or judge) (Jonakait, 2003). In Maine

when an expert is called to the stand they are sworn in by the court clerk. The party who called the witness (prosecution or defense) is responsible for asking the witness questions to establish to the court that the witness is an expert in the area he or she is going to testify on. These questions, known as qualifying questions, include the witness's education, training and certifications (if any) and the attorney usually asks the witness if they have testified in previous cases in Maine. The attorney then asks the witness to explain the scientific foundations of the evidence, how comparison are carried out and how conclusions are rendered. At this point the attorney will ask the court to accept the witness as an expert, and unless the opposing counsel objects, the witness will be accepted by the judge as an expert and will be allowed to give direct and opinion testimony. If the opposing counsel objects, additional qualifying questions are usually asked of the witness.

1.5 Overview of Jury Trials and Jury Research in the United States

The first recorded attempt to count the number of jury trials in the United States began with the Chicago Jury project in 1955. Finding an accurate number did not come easily as some jurisdictions kept incomplete records and some jurisdictions kept no records at all (Devine, 2012). At that time it was estimated that 55,670 trials occurred in the United States each year (Kalven et al., 1966). In 2006 the National Center for State Courts estimated that there were 148,558 state trials and 5,563 state trials that year. Of these trials, felony crimes made up 47%, misdemeanor offenses 19%, 31% were civil trials and 4% were listed as "other" (Mize et al., 2007).

Approximately 32 million US citizens are called for jury duty each year and 1.5 million are empaneled. An attempt to quantify the number of jury studies that have been carried out in the United States is a difficult task. The first published estimate which was carried out suggested 72 jury research studies involving mock juries had been undertaken (Bray and Kerr, 1979). Later estimates, which were calculated by looking at jury research published in the leading ten U.S. journals between 1977 and 1994, suggested that 265 jury research studies were published, approximately 15 per year (Roesch and Zapf, 1999). The vast majority (89%) of these were criminal cases and the most common focus (20%) of the research was performance of the witnesses. Devine makes a plausible estimate that in the region of 1500 jury research studies have been carried out between 1977 and 2011 (Devine, 2012).

1.6 Types of Juror and Jury Research

Jury research is not a new phenomenon and interest in how juries make decisions and render verdicts has been studied for the past century (Caldwell, 1929, Hurt and Anapol, 1972, Anapol, 1973, Kalven et al., 1966, Burtt, 1931). Early jury research focused on the decision of juries in cases relating to trademarks and patents and later the focus shifted to a broad range of topics, including juror understanding of the law and juror response to witnesses (Penrod et al., 2011). The earlier research into jury decision making involved simple comparisons between jury verdicts and which verdict the judges themselves would have issued (Kalven et al., 1966, Caldwell, 1929). The simplest and most common studies involved showing mock jurors recorded dramatized trials and then collecting various data relating to their experiences and decisions (Podlas, 2005, Gerbasi et al., 1977, Miller et al., 2011, Nuñez et al., 2011). Many other studies use populations

of citizens who were called for jury duty and were not selected as a juror. More sophisticated studies involved real juries over multiple jurisdictions and over multiple years (Hans et al., 1998, Bowers, 1994, Diamond et al., 2006, Diamond et al., 2003).

Research in response to US Supreme Court decisions began in the 1960s and bloomed in the 1980s. During this time the Supreme Court of the United States ruled that juries as small as 6 members and non-unanimous verdicts of at least 9 jurors were both constitutional. Research on how jury size and unanimous/ non-unanimous verdicts influenced jury decision making sought to make sense of these new jury criteria (Abramson, 1994). Significant understanding of the experiences and expectations of jurors came from landmark research published in 1966 known as The University of Chicago Jury Project (Broeder, 1959, Kalven et al., 1966). This research, which was undertaken by the Chicago School of Law, and sponsored by the Ford Foundation, was the first in-depth study of judge and jury decision making. In the 1980's research was published on the influence of jury instructions, racial bias and death penalty qualification on jury decision making (Piel, 2011, Jonakait, 2003).

Researchers have employed numerous approaches to acquire information on juror understanding, comprehension and interpretation of evidence presented at trials. Researchers usually have to choose between a research design which will have strong internal validity, which is the degree to which accurate conclusions can be drawn about causality and external validity and how easily the conclusions of the research can apply to other samples (Devine, 2012). Internal validity, as it relates to jury research, requires the researcher to have strong control of the variables being tested, which is very difficult in field experiments with real juries and real trials. Jury research with strong internal

validity is the most prevalent research available in the literature and is often based on large groups of mock jurors (university students, community members and individuals called for jury service but not selected at trial) watching a simulated trial. Researchers in this setting can use control groups and control for the variables they wish to study.

Some jury researchers have also attempted to use their research to be able to predict the decisions and outcomes of future juries. Research designs with high external validity, which have the ability to generalize results over future populations, usually require realism in the population sample (Devine, 2012). Realistic samples usually require real jurors and are based upon real trials and this makes it difficult to control for trial specific variables, such as types of evidence presented, attorney objections, how long the trial goes on for, to name a few. Studies based upon realistic samples are advantageous because their results can apply to future trials.

Studies differ in research design (experimental and non-experimental), in research setting (laboratory or field) and participants (students, community members and jurors). Most research in the literature falls into the experimental, laboratory and student/ community member category. The choice of trial format (case summaries, edited transcripts, audiotape, videotape, actual trial) is another variation. This choice will lead to different levels of realism for the mock jurors and different outcomes for the application of the research (Devine, 2012). The vast majority of research in the literature falls into the Experimental-Laboratory-Nonjuror-Nontrial category (Figure 1) because research through interviews of real jurors is difficult to do often requiring judicial permission (Devine, 2012).

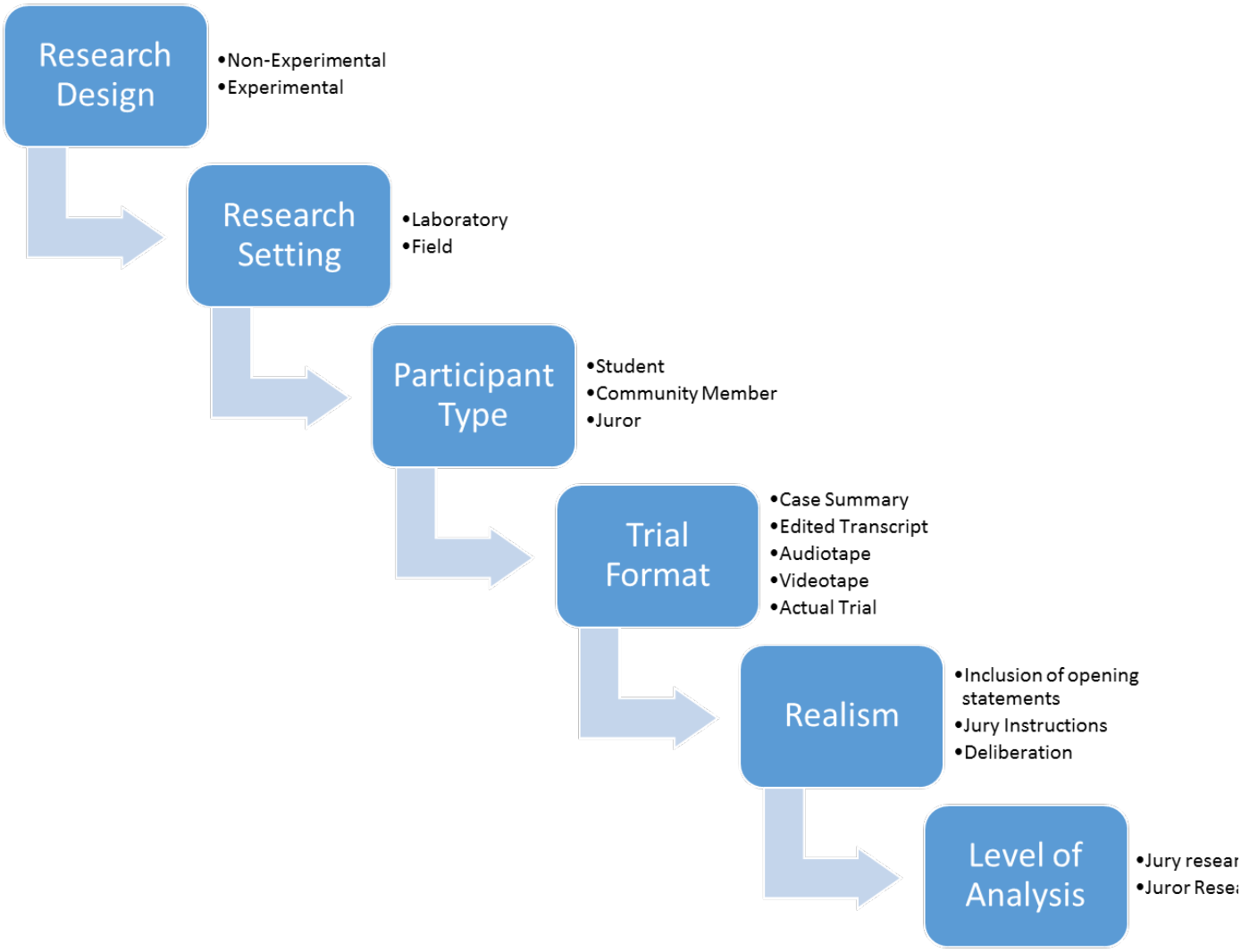

Figure 1: Schematic of variety of approaches to jury research

In addition to these research dimensions, the focus of the research needs to be considered. There is a wealth of research on juror expectations of scientific evidence, for example investigating the CSI effect, where jurors anticipate forensic evidence from crime scenes, (Diamond, 1993, Baskin and Sommers, 2010, Cole and Dioso-Villa, 2009, Shelton et al., 2006), how race and gender impacts decision making (Sommers, 2006, Fischer, 1997), the difference between verdicts of judges and juries (Caldwell, 1929, Farrell and Givelber, 2010, Eisenberg et al., 2005) and the personality types of death

penalty qualified juries (Bray and Noble, 1987).

Jury research is further broken down into levels; jury level and juror level. Jury level research is focused on social decision schemes and how groups make decisions. This research is often verdict driven. Juror level research enquires into the juror's own perceptions and responses. Much of the research in the literature is based upon jury level, group decision making, by looking at the process of deliberation and verdicts.

The body of research, however, on how jurors interpret specific forensic science evidence, is small (Lieberman et al., 2008, Thompson and Newman, 2015, Bromby, 2011). These studies rely upon responses from undergraduate students (Podlas, 2005, Ranadive, 2015) and responses from individuals who were called to jury duty but eliminated from the final jury selection and simulated juries watching mock trials. Critics of simulated juries, made up of students, caution inferences made to real juries in civil and criminal trials (Bornstein and Rajki, 1994, Nuñez et al., 2011, Gerbasi et al., 1977). A summary of the primary research referenced in this thesis is illustrated in Table 1.

With the increased use of expert testimony to explain complex scientific data, studies have been carried out to ascertain how well jurors deal with interpretation of this evidence (Vidmar, 2005). Table 1 illustrates the lack of research in the area of how real juries interpret real forensic science testimony. What research does exists has tended to focus on juror understanding of DNA evidence (Lieberman et al., 2008, Hans et al., 2011) and suggests that jurors find DNA evidence more accurate and persuasive than other forensic science testimony. Other research has investigated how the presentation style

of the expert witness influences jurors. Jurors are influenced more by testimony given in narrative form than testimony based on statistics or numerical values (Krauss and Sales, 2001). The few studies that have questioned jurors after criminal trials did not focus on whether the jury found the forensic science witnesses reliable or credible (Sanders, 1993, Cooper et al., 1996).

Table 1: Overview of jury research

= Research based on real juries = Research based on real juries and forensic science evidence

Title	Author	Year	Research Method	Jury Type and number of participants	Trial Types/ data collection	Main objective of the research
Behind Locked Doors: An Investigation of Certain Trial and Jury Variables by Means of a Video Taped Trial.	Anapol, M. M.	1973	Quantitative	University Undergraduates and people who served on real juries. N= 60 (mock juries of 12 or 6 per variable)	Video reenactment of a civil trial	Examination of the effects of different variables on jury understanding of evidence
Group decision-making: An economic analysis of social influence and individual difference in experimental juries	Baddley, M. and Parkinson S.	2012	Quantitative	University Undergraduates. N=63	Written summary of a case	Compromise and conformity injury-like groups
Crime-show-viewing habits and public attitudes toward forensic evidence: The "CSI effect" revisited.	Baskin D. R. and Sommers I. B.	2010	Quantitative	Telephone survey with registered California voters N=1201	Hypothetical questions	The expectation of forensic evidence give crime type
Extra-legal factors and product liability: The influence of mock jurors' demographic characteristics and intuitions about the cause of an injury	Bornstein, B. H. and Rajki, M	1994	Quantitative	American citizens selected on the street N=239	Hypothetical case	The effects of juror demographic characteristics on determining cause of plaintiff's injuries
Capital Jury Project: Rationale, Design, and Preview of Early Findings	Bowers, W.	1944	Qualitative	Death-penalty juries N=120	Real trials	What influences jurors decision to punish by death or life sentence
Authoritarianism and decisions of mock juries: Evidence of jury bias and group polarization	Bray, R. M. and Noble A. M.	1987	Quantitative	Mock Jurors N=257	Listened to a recorded trial	The effects of authoritarian personality on verdicts

Title	Author	Year	Research Method	Jury Type and number of participants	Trial Types/ data collection	Main objective of the research
Improving comprehension of jury instructions with audio-visual presentation	Brewer, N. Harvey, S. & Semmler, C.	2004	Quantitative	Mock Jurors 90 law students 90 untrained adults	Listened to audio of mock testimony	Factors that affect juror understanding of legal instructions
The effects of DNA evidence on homicide cases in court	Briody, M.	2004	Quantitative	None	Analyzed 150 homicide cases and verdicts	What effect does DNA evidence have on jurors decisions in homicide cases
Complex scientific testimony: How do jurors make decisions?	Cooper, J., Bennett, E. A. & Sukel, H. L.	1996	Quantitative	Mock jurors N=54	Video recording of a mock trial	How jurors decide if certain chemicals could cause a plaintiff's injury
Expert Witness Confidence and Juror Personality: Their Impact on Credibility and Persuasion in the Courtroom.	Cramer, R. J., Brodsky, S. L., Decoster, J.	2009	Quantitative	University students, N=317	Filmed scenario of a simulated trial	Impact of psychology expert testimony on juror decision making
The influence of the size and decision rule in jury decision-making	DePaul Velasco, P.	1995	Quantitative	Undergraduate students, N=216	Listened to a real trial	Investigation of differences in verdicts between 6 and 12 member juries and unanimous and majority verdicts
Juror discussions during civil trials: Studying an Arizona innovation	Diamond, S. S. et al	2003	Mixed Methods	None	Analyzed questions jurors had recorded during the trial	The effects of juror discussions before deliberation

Title	Author	Year	Research Method	Jury Type and number of participants	Trial Types/ data collection	Main objective of the research
Blindfolding the Jury to Verdict Consequences: Damages, Experts, and the Civil Jury	Diamond, S. S. and Casper, J. D.	1992	Quantitative	Mock Jurors N=1022	12 versions of simulated trials	Examination of variables that influence verdicts and damage awards
Educating jurors about forensic evidence: using an expert witness and judicial instructions to mitigate the impact of invalid forensic science testimony	Eastwood, J. and Caldwell, J.	2015	Quantitative	Mock Jurors N=155	Mock trials	Factors that mitigate the influence of weak or erroneous testimony
Getting to (not) guilty: examining jurors' deliberative processes in, and beyond, the context of a mock rape trial.	Ellison and Munro	2010	Mixed Methods	University undergraduate students, N=76	9 mini reconstructed mock trials	Examination of variables
Gender effects on individual verdicts and on mock jury verdicts in a simulated acquaintance rape trial.	Fisher, G. J.	1997	Quantitative	University undergraduate students, N=624	Read case summaries	The effects of gender in verdict decisions
How jurors evaluate fingerprint evidence: The relative importance of match language, method information and error acknowledgement	Garrett, B. and Mitchell, G.	2013	Quantitative	Online solicitation of individuals in India and the USA, N=1252	Reading hypothetical cases	How the method of testimony influences decisions on fingerprint evidence
Permitting jury discussions during trial: Impact of the Arizona reform	Hannaford, P. L. et al	2000	Quantitative	Real Jurors, N=170	Questionnaires	Comparing juries who were and were not allowed discuss the case prior to deliberations

Title	Author	Year	Research Method	Jury Type and number of participants	Trial Types/ data collection	Main objective of the research
Science in the Jury Box: Jurors' Comprehension of Mitochondrial DNA Evidence	Hans, V. et al	2011	Quantitative	Citizens called for jury service N=480	Questionnaires	Investigation of jurors understanding of mitochondrial DNA evidence
Using multimedia to support jury understanding of DNA profiling evidence	Hewson, L. and Goodman-Delahunty, J.	2008	Quantitative	Mock jurors, N=137	Audiotaped mock trials	The effects of multimedia presentations on jurors' understanding of DNA evidence
The effects of jury size, evidence complexity, and note taking on jury process and performance in a civil trial	Horowitz, I. A. and Bordens, K. S.	2002	Quantitative	Mock jurors, N=576	Videotaped civil trial	Examination of factors that affect juror decision making
The effects of complexity on jurors' verdicts and construction of evidence	Horowitz, I. A. and Bordens, K. S.	2001	Quantitative	Mock Jurors, N=120	Mock trials	The effect of complex evidence on juror decision making
The American jury	Kalven, H. et al	1966	Quantitative	Judges, N=555	Judges filled out questionnaires and this information was compiled with information known about the trial as well as the jury's verdict	Examined verdict differences between judges and juries and the potential reasons

Title	Author	Year	Research Method	Jury Type and number of participants	Trial Types/ data collection	Main objective of the research
The effects of clinical and scientific expert testimony on juror decision making in capital sentencing	Krauss, D. A and Sales, B. D.	2001	Quantitative	Undergraduate students, N=208	Simulated trial	How different types of testimony influence juror decision making
Gold versus platinum: Do jurors recognize the superiority and limitations of DNA evidence compared to other types of forensic evidence?	Liberman, J. D. et al	2008	Quantitative	Undergraduate students and lay persons, N=383	Mock jurors surveyed about expectations	How jurors decide to place weight on DNA, fingerprints, hairs, fibers, alcohol and drug evidence
The effects of deliberations and religious identity on mock jurors' verdicts	Miller, M. K, et al	2011	Quantitative	University Undergraduate students, N=105	Mock cases in written scenarios	Influence of deliberations and religious identity on verdicts
Rule departures and making law: Juries and their verdicts	Myers, M.	1979	Quantitative	No jurors participated	Analysis of information from police and prosecutors	Comparison of Jury verdicts with the case presented at court
Jury Deliberations in the Trial of U.S. v. John DeLorean: A Case Analysis of Groupthink Avoidance and an Enhanced Framework.	Neck, C. P. and Moorhead, G.	1992	Qualitative	Real Jurors, N=12	Analysis of jury deliberations in one case	Examination of weaknesses in decision making when presented complex evidence
Jurors' Perceptions of Ethnic Minority Attorneys: Are We in a Post-Racial Era?	Phillips, M. R.	2010	Quantitative	Jury eligible individuals, N=136	Questionnaire	Influence of attorney's race on juror decision making

Title	Author	Year	Research Method	Jury Type and number of participants	Trial Types/ data collection	Main objective of the research
Note taking can aid juror recall	Rosenhan, D. L., et al	1994	Quantitative	University undergraduate students, N=72	Simulated trial	Can juror note taking aid recall of information
The uses and effects of forensic science in the adjudication of felony cases	**Ryan, P., et al**	**1987**	**Quantitative**	**Real jurors, N=290**	**Answered questionnaires about their general understanding of forensic science evidence**	**How forensic science evidence presented at trial influences felony cases**
Legal and Psychological Bases of Expert Testimony: Surveys of the Law and of Jurors.	**Saks, M. J. and Wissler, R. L.**	**1984**	**Qualitative**	**Individuals scheduled for jury duty, N=25 (25 real jurors) and N=72 (mock jurors)**	**Interviews**	**Juror perceptions of experts (Chemistry, firearms, handwriting analysis) testimony**
Jury deliberation in a complex case: Havner v. Merrell Dow Pharmaceuticals.	Sanders, J.	1993	Qualitative	Real jurors, N=12	Reviewed recorded deliberations	Examined jury deliberations around complex evidence in a single case
Juror Reactions to DNA Evidence.	Schklar, J. & Diamond, S.	1999	Quantitative	Undergraduate university students, N=219	Case descriptions with random match probabilities of DNA	How well do mock jurors understand DNA evidence

Title	Author	Year	Research Method	Jury Type and number of participants	Trial Types/ data collection	Main objective of the research
Communicating forensic science	Schweitzer, N.J.	2016	Quantitative	Online participants (N=876) and some in person jurors	Video reenactments of trials	How the method of expert testimony influences mock juror decision making
A Study of Juror Expectations and Demands Concerning Scientific Evidence: Does the 'CSI Effect 'Exist?	Shelton, H., et al	2006	Quantitative	Individuals summoned to jury duty	Interviews of potentials jurors on expectations of scientific evidence	Do mock jurors have expectations of forensic science evidence given crime type
On racial diversity and group decision making: identifying multiple effects of racial composition on jury deliberations.	Sommers, S.	2006	Quantitative	Members of the community, N=200	Video of simulated trial	The effect of juror race on deliberations
The jury as critic: An empirical look at how capital juries perceive expert and lay testimony	Sundby, S. E.	1997	Qualitative	Real Jurors, N= 152 (36 cases)	Interviews of jurors after trials	Further investigates the findings of the capital jury project
Lay understanding of forensic statistics: Evaluation of random match probabilities, likelihood ratios, and verbal equivalents	Thompson, W. C. and Newman, E. J.	2015	Quantitative	Online solicitation of individuals in the USA, N=541	Hypothetical case	The influence of method of testimony had on juror understanding of forensic evidence

Title	Author	Year	Research Method	Jury Type and number of participants	Trial Types/ data collection	Main objective of the research
Jury deliberation: An observation study	Winship, G.	2000	Quantitative	Mock Jurors, N=12	Videotaped mock trials	Group-analytic perspective of jury deliberations
The Influence of Jurors' Perceptions of Attorneys and Their Performance on Verdict.	Wood, S. M. et al	2011	Quantitative	Individuals who had previously been jurors, 14 to 2 years prior to interview, N=572	Post-trial interviews of real jurors	Examination of the influences of attorney's performance at trial on jury verdicts

1.7 Conclusion

It is clear to the stakeholders in the U.S. judicial system that jury research is important (Devine et al., 2001, Erlander, 1970, Erlanger, 1969, White, 1979, Wiener et al., 2011). Research into how juries interpret forensic evidence and how forensic evidence influences jury decision making is severely lacking. This research begins the process of filling the gap in the literature on jury's perceptions of forensic science testimony.

In the post NAS report (2009) era, where many of the forensic science disciplines are taking steps to address weaknesses in their science (Cole, 2009, Dror and Cole, 2010), insight into how juries perceive forensic science evidence is very important. In response to the NAS report's statement, "jurors use and comprehension of forensic evidence is not well studied", this research study sought to gain a better understanding of jurors' perceptions of evidence reliability and how the forensic evidence impacted decision making. This study highlights the intersection of witness credibility and evidence reliability in the jurors' minds. NIST is currently pursuing two paths towards strengthening forensic science, 1) certification of forensic examiners and 2) accreditation of forensic science laboratories.

Certifications and accreditation are important corner stones in forensic science, however the NAS report (National Research Council, 2009) highlighted a lack of research on the underlying foundation of many of the forensic science disciplines with regards to validity and reliability. The PCAST report (Holdren et al., 2016) focused on the types of research studies which lend themselves to developing an understanding of the

foundational validity of the comparative forensic sciences. This report emphasized the importance of black box studies (where forensic scientists examine evidence and report conclusions as they would in case work) to establish the accuracy of the science and in turn, the reliability of expert testimony. Additional research into the validity and reliability of the forensic sciences must be made a much higher priority. This means that the impetus for evaluating scientific reliability of all forensic science disciplines is of paramount importance. When expert witnesses testify in court, we owe it to the jury to ensure that the forensic evidence is based on a solid scientific foundation and when the jury places their trust in the forensic expert witness, this trust is warranted.

CHAPTER 2: Methodology

The aims of this research were to 1) investigate how jurors process the information presented by forensic scientists along with the other information learned during the course of the trial and to determine how important forensic evidence was to the jurors' decision making, 2) to gain an understanding of the factors that influence jurors' views of the credibility of forensic science expert witnesses and the reliability of the evidence and 3) to determine if jurors understand and place the appropriate weight on forensic science testimony and if there are factors that influence a juror's understanding. A parallel convergent exploratory mixed methods design was used to approach these research questions (Figure 2).

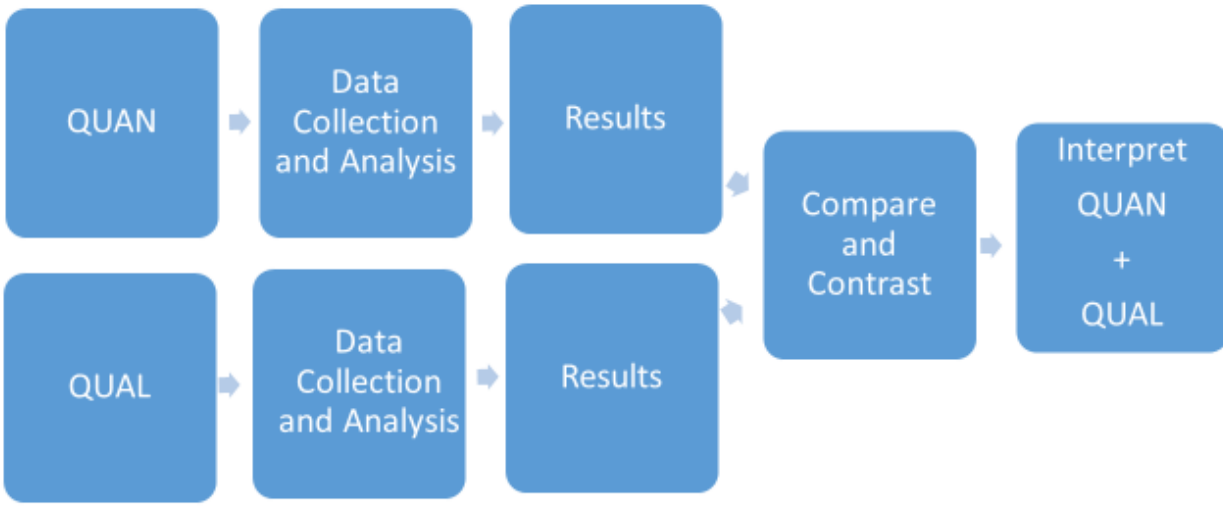

Figure 2: Parallel Convergent Mixed Method Approach

2.1 Research Process

The data collection was carried out over a 24 month period. The data collection tools (survey and interview questions) were developed and the judicial approval was

sought and received. The researcher attended the trials and watched the portions where forensic science testimony was given by experts called by the prosecution as these were the only forensic science witnesses giving evidence in the trials where the research was approved. Following the trial, a survey was posted to all jurors and alternate jurors. Jurors (N=29) returned the survey to the researcher and a subset of these jurors (N=22) participated in phone interviews. The data were then organized and analyzed. Figure 3 outlines the research process.

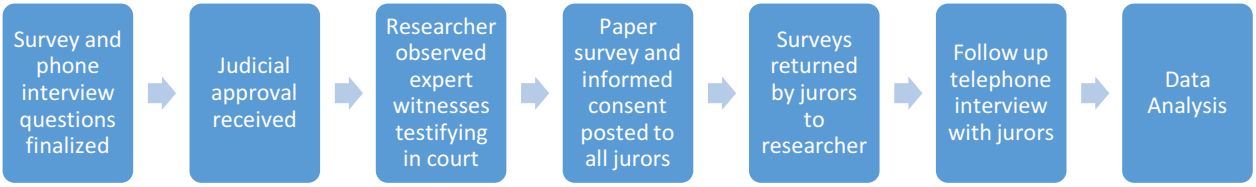

Figure 3: Overview of data collection process

2.2 Design Rational

Previous research into factors that influence juror interpretation of evidence fall into two categories: research based on populations of mock jurors and research based on populations of real jurors. Our understanding of how real jurors process and comprehend testimony comes from data collected by surveys, interviews of jurors and by listening to jury deliberation or reading notes taken by jurors during the trial. Research involving mock jurors often involves the mock juror reading partial trial transcripts or watching mock trials, followed by answering questions. The vast majority of our knowledge of how jurors and juries make decisions and interpret testimony comes from surveys of mock jurors, and to a much lesser extent surveys of real jurors.

This work has been devised so as to add to the knowledge base on factors that influence real jurors' decision making, with a specific focus on scientific forensic testimony. Choosing to research the perceptions of real jurors who presided over homicide trials significantly narrowed the population pool. To be able to understand the impact of forensic testimony on this realistic jury population, a compromise in sample size was expected. To strengthen the reliability and validity of the research results, this research followed a mixed method research design. A process called triangulation is used to measure the rigor of research conclusions by comparing results across two different sources. In a very similar way, mixed methods research also relies on the practice of seeking data from two complementary sources and is particularly useful when one data source can compensate for the weaknesses of another (Andrew and Halcomb, 2009). Mixed method research has been defined by research scholars as a method of inquiry where both qualitative and quantitative findings are collected and can be mixed in order to gain a deeper understanding of the issue being investigated than either model could achieve alone (Creswell and Clark, 2007, Creswell, 2013). A mixed method design was most suited to the task of gaining a deeper understanding of how jurors interpreted and used forensic evidence, in their decision making.

A second reason for choosing a mixed methods design was due to the limited evidence of the relationship between forensic science testimony and jurors' decision-making. This research supported the need for explorative qualitative investigation aimed at fleshing out known themes as well as exploring undefined phenomena related to the relationship between the forensic science witness and the juror. The quantitative data (although limited because of sample size) was collected to support the qualitative themes

to present a broader view to the readers and stakeholders who may be interested in this research in the future. It was hoped that by collecting data by these two methods the external validity of the results would be increased.

2.3 Study Feasibility and Scope

In the United States an individual has the right to a jury trial in all felony cases and in misdemeanor cases where punishment includes imprisonment of 6 months or more (Samaha, 2015). The most recent national statistics indicate that only 5% of felony cases go to trial and in the remaining 95% of cases the defendant pleads to the charges without a trial (Statistics., 2004) The jury trial process is costly and inefficient and reserved for the most serious of criminal cases (Samaha, 2015).

This research focused on the most serious of criminal charge in the State of Maine which is the charge of homicide. There were three main reasons for this narrow focus on how jurors interpret and use forensic science testimony in homicide trials; firstly homicide cases are considered very important by the prosecution and defense teams as the stakes are high for both sides; secondly the chance of forensic scientists testifying in homicide trials is high, making these cases a rich pool from which to gather data, and finally from a logistical point of view it was easier to determine when an expert witness was to appear in a homicide case and as such attend that part of the trial. Unlike other felonies in Maine, such as gross sexual assault or burglary offenses which are organized by numerous district attorneys and administrative staff, homicide trials are centrally organized by a single employee of the attorney general's office. In addition to this, each homicide case is assigned a witness advocate whose job it is to coordinate witnesses for testimony at the

trial. Both the single point of contact and the knowledge the witness advocate had regarding witness testimony made it feasible to attend the trials to watch the forensic scientists testify. Watching the trials and/or reading the trial transcripts was an important aspect of this study.

Although trial dates and venues can change, homicide trials in Maine once scheduled, usually proceed according to plan. In addition to this was is possible to estimate the day and time a prosecution expert witness was expected to testify. In contrast, defense expert witnesses do not testify as often as prosecution experts and knowing when they will be called to the witness stand is very difficult to estimate. For this reason, jurors were not asked questions about expert witnesses called by the defense.

The focus of the research and the plan to attend the trials to watch the testimony dictated a narrow scope which focused only on homicide trials where prosecution attorneys called forensic scientists to testify and where attendance at the trial was possible in order to observe the testimony. In a few instances where attendance at the trial was not possible the trial transcript was obtained. In these cases, the transcriptions took the place of the observations of the trial testimony. In all of the cases observed no defense forensic science expert witnesses were called in any trial and as such only the juror's perception of the forensic expert appearing for the prosecution was possible. This is a limitation which can only be resolved by a broader body of work.

This research did not explore the scientific strengths, weaknesses or reliability of the different forensic science evidence types presented to the jury. The aim of the research was instead to focus on how the jurors interpreted and understood the forensic

science testimony presented to them, irrespective of its scientific robustness.

2.4 Overview of the Trial System in the State of Maine

The Court system at the state level in the United States consists of district courts, superior courts and the Supreme Court. This is true for the State of Maine where this work was undertaken. The Maine Supreme Court hears appeals from the lower courts. The District court hears civil, criminal and family matters and always sits without a jury. The Superior Court is the court of general jurisdiction and is the only level of court where jury trials are available. As such, the data collected came from surveys and interviews of jurors who watched expert witness testimony in Maine superior courts, highlighted in green in Figure 4.

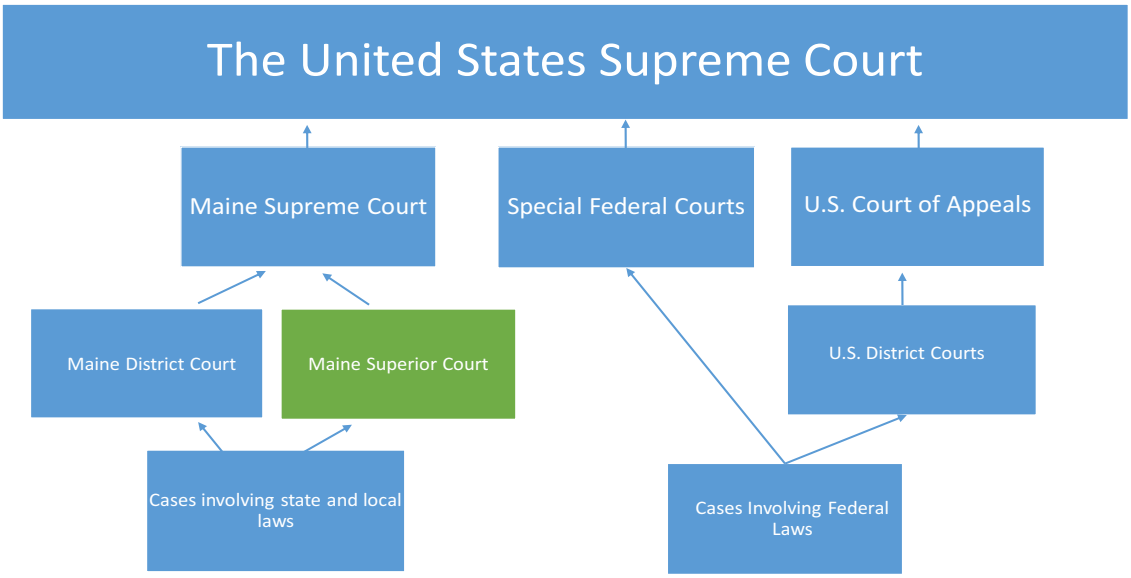

Figure 4: Schematic of Trial Court System in the United States

2.5 Population and Sampling

Unlike other approaches to gathering data where random or stratified samples are desired in order to be able to extrapolate the results to the general population one is studying, this research relied on a convenience sample (Utts and Heckard, 2011). This meant that access to the trials, and by consequence to the jurors involved in those trials were included in this study were predicated on the receipt of judicial approval and the nature of the cases chosen rested very much with the judge, although homicide cases were suggested for the reasons expressed previously. Creswell states that convenience samples, "save time, money, and effort, but at the expense of information and credibility" (Creswell, 2012). Juries themselves are also small populations, with 12 members and sometimes 3-4 alternate or backup jurors. Jurors are a special population and cannot be compelled in Maine to take part in any research and studies also show that jurors tend to try to distance themselves from the case after the trial (Finsen, 2012) making research with real jurors complex and challenging.

The sample population for this study were jurors and alternate jurors who heard forensic science testimony in homicide trials in the State of Maine. Maine is the most northern state on the east coast (Figure 5) in the United States of America and has a population of 1,329,328 (Bureau, 2015).

Figure 5: Map of the United States with the State of Maine highlighted.

Jurors in Maine are released from official civil service approximately forty five days after they are impaneled. The sample in this study included all jurors and alternates who responded to a paper survey which had been posted to them as part of the research after they had been fully released from jury service.

2.6 Judicial Approval

The names and addresses of individuals who serve as jurors in the State of Maine are confidential and not available without judicial approval. Title 14 of the Maine Revised Statue, Section 1254-B (3) sets forth exceptions to juror confidentiality;

> *"Once the period of juror service has expired, a person seeking the names of the jurors may file with the court a written request for disclosure of the names of the jurors. The request must be accompanied by an affidavit stating the basis for the request. The court may disclose the names of the jurors only if the court determines that the disclosure is in the interests of justice. The factors the court may consider in determining if the disclosure is in the interests of justice include, but are not limited to, encouraging candid responses from prospective jurors, the safety and privacy interests of prospective jurors and the interests of the*

media and the public in ensuring that trials are conducted ethically and without bias" (14 M.R.S § 1254-B (3))

Judicial approval to contact jurors after homicide trials was sought in May 2014 and granted in August 2014. Chief Justice of the Maine Superior Courts, Jeffrey Humphrey, issued a judicial order for 12 months (Appendix 1) which expired initially at the end of July 2015 and was extended until July 2016 by Chief Justice Ronald Cole who replaced chief Justice Humphrey on his retirement. Both the paper survey and the questions that were asked during the telephone interview were modified and then approved by Justice Humphrey. The judicial order required that the questions on the paper survey and during the juror interviews sought information about the individual juror's perspectives and limited inquiry into how the juror viewed the way in which fellow jurors dealt with the scientific evidence and how group decision making took place. To ensure juror confidentiality and anonymity, it was also required to use pseudonyms for each juror. Pseudonyms of individuals who were jurors in the same trial were given names that began with the same letter. The 9 trials were taken out of chronological order and then labeled A through I to establish another layer of anonymity to protect the jurors.

2.7 Ethical Issues

Ethical approval was granted by the University Ethics committee and all Jurors filled out an informed consent form prior to answering questions on the paper survey and a second informed consent form before the phone interview (Appendices B and C). This ensured that the jurors knew that their participation was voluntary and not part of their civic duty.

2.8 Data Collection

2.8.1 Quantitative Data

The majority of the quantitative data in this study was collected on surveys the jurors filled out. The survey used in this study included 13 standard questions followed by trial specific questions related to the types of scientific testimony given. Of the 13 standard questions, 6 asked demographic information (Appendix 4, Questions 1-5 & 11).

The survey asked 4 questions which were related to how jurors accessed the news/current affairs and their TV watching habits (Appendix 4, Questions 7-10).

On each survey jurors were asked 5 general questions (Appendix 4, Questions 12, 13, 27, 28 & 32) and three questions about each of the expert witnesses they watched during the trial (Appendix 4, Questions 14, 15 & 29). If the expert used a presentation an additional question was asked (Appendix 4, Question 18).

Two questions asked during the phone interview were also used to generate quantitative data (Appendix 5, Questions 5 & 8).

2.8.2 Qualitative Data

The initial qualitative data was collected through open ended questions in the survey. Jurors were asked how reliable they thought each of the forensic science disciplines were and were asked to explain why (Appendix 5, Question 16, 21 & 25).

Jurors were also asked an opened ended question in the survey about the greatest challenge they experienced with understanding the expert forensic evidence (Appendix 4, Question 32). This question was asked to elicit information from the jurors as to any challenges they experienced interpreting the forensic science testimony.

The vast majority of the qualitative data came from phone interviews with 22 jurors. Phone interviews were carried out using Skype® (version 7.33.01.104) with the plug-in Vodburner® (version 1.1.0.203). Vodburner recorded the calls and these were transcribed using an online service. The phone calls lasted from 32 minutes to 72 minutes and the length depended on the responses the jurors gave. Jurors did not answer all the questions; this was sometimes due to poor memory or inability to answer the question. The interviews were structured by the particular questions that were asked of each juror, but jurors were given flexibility to speak for as long as they needed to. A great deal of data was generated by allowing this free flow of information. The questions asked during the phone interviews (Appendix 5) gave a deeper meaning to the quantitative data and helped answer the research questions and hypotheses posed at the beginning of this research.

2.9 Instrumentation

The quantitative data were organized, stored and analyzed using Microsoft Excel (2013). The data in the frequency tables and the charts in chapters 3 and 4 were generated in Excel and the more advanced statistical calculations were carried out using IBM Statistical Package for the Social Sciences (SPSS, version 21). SPSS was used to determine if there were correlations between variables and the level of significance. Intra-observer calculations were carried out to determine the variability within each juror when ranked data was collected.

The qualitative data were organized, cataloged and analyzed using Nvivo® (version 11). Nvivo allowed the transcribed interviews to be uploaded and then broken down into themes and subthemes. The software facilitated the organization of statements made

by jurors into meaningful groups.

Researcher bias is an inherent concern in qualitative research, where the researcher themselves analyses and interprets the data and forms conclusions. Bias was minimized by developing a series of structured interview questions and making these questions the backbone of the interview. In phenomenological research, as well as all qualitative research, it is important to allow the subject being interviewed to express freely their experience of the phenomenon and that was done throughout this work. When jurors veered away from the question asked the resultant side stories are also of great value and provide a rich vein for gaining understanding of the experience of the juror.

A rapport was developed with the jurors during the phone interview. It was clear that the jurors used the interview to explain their experience and were frank and comprehensive about their descriptions of how they understood and valued the forensic science evidence.

2.10 Data Analysis Procedures

The quantitative survey data and the qualitative interview data were collected concurrently and the data were not merged until the results phase of this research. The survey generated many variables for analysis. The quantitative data derived primarily from the survey was considered supportive of the qualitative interview data and this type of mixed methods research is designated as QUAL/quan, where the quantitative data supported the more important qualitative data and made the conclusions of this research more robust.

2.10.1 Qualitative Data Analysis

The process of data analysis in this phenomenological phase was a cyclic one, meaning that the analysis of statements and coding of key phrases was constantly evaluated and re-evaluated. In order to minimize bias while undertaking the iterative process of developing themes, the researcher made a conscious effort to bracket any epoché (to suspend judgement) held regarding the jurors' perceptions of factors that influence decision making (Moustakas, 1994).

The qualitative data were organized in Nvivo (version 11) and analyzed in four steps. The first step was to organize the jurors' responses by the question asked during the interview. This was done by making each question a node. This grouped all the responses to the same question and allowed a general sense of the jurors' perceptions regarding the expert witnesses at the trials to be formed.

The next step was to organize the jurors' responses into broad categories based on the overarching goals of the research. Given the gap in the literature for research involving real jurors, highlighted in Chapter 1, all the factors that influence jurors' perceptions of expert witnesses and forensic science testimony were not known at the outset of this research. It was essential for the researcher to analyze the qualitative data for new and emerging themes.

The responses in the categories grouped in Table 2 came from direct questions and unsolicited responses and bridges the questions asked during the interview.

Table 2: Broad categories of juror responses to interview questions

Broad Categories	Number of sources (Jurors)	Number of statements
Jurors' comments on the lawyers	6	13
Did the Lawyers ask the necessary questions?	16	17
Juror's comments on the judge	3	3
Jurors' definition of an expert witness	21	26
Jurors' definition of the term "unique"	20	20
Jurors' comments on the deliberation process	14	20
Jurors' highest level of science education	21	21
When juror's took last science class (in years)	21	21
Jurors perception of how their science knowledge impacted their understanding of the testimony	19	20
Jurors' perceptions of the most important qualifications of an expert witness	22	26
Why are qualifications or experience more important in an expert witness	20	24
Jurors' comments on how they know if evidence is important	18	21
Jurors' comments on how they know if evidence is reliable	20	23
Jurors' comments on how they know if the expert witness is credible	21	24
Jurors' perceptions of whether old/traditional methods or new technology is more reliable	19	22
Jurors' comments on what was the strongest evidence/ evidence that most impacted decision making	21	21
Jurors' comments on which forensic science disciplines are more reliable than others	17	22
Jurors' greatest challenge in evaluating the evidence	19	19
Jurors' emotional responses	11	15
Juror's comments on their own current or pre-retirement occupation	11	11

Based on these categorizations the data were available for a more detailed analysis aimed at answering the research questions and hypotheses. Step three involved extracting significant statements related to the research questions and hypotheses. This was done by grouping statements together based on deductive coding given current themes in the literature, such as the story model of juror decision making, central and peripheral processing of information, the theory that juror decision making follow the

strength of the evidence, the C.S. I. effect and the importance of the deliberation process.

Due to the gap in the literature on the influence of forensic science testimony on jurors' decision-making, the majority of the coding of significant statements was based on in vivo coding (using the participants' exact words) (Miles and Huberman, 1994). This final step of analysis generated emergent themes related to forensic scientist credibility, evidence reliability, jurors' perceptions of the different forensic science disciplines, and jurors' reported greatest challenge in understanding the forensic science evidence among other themes. The current and emergent themes are discussed in chapters 3, 4 and 5.

2.10.2 Quantitative Data Analysis

The quantitative data was organized in Excel spreadsheets. All data transcription from the surveys into the excel spreadsheets was double checked to ensure data were valid and reliable and all quantitative calculations were carried out in Excel (version 2013). The answers on the survey in the form of Likert scales were converted to numerical data as illustrated in Table 3.

Table 3: Number of hours jurors report watching TV converted to numerical values

Likert Scale	Numerical value
Do not watch TV	0
Less than 1 hour	1
1-4 hours	2
5-12 hours	3
More than 12 hours	4

Jurors ranked the qualifications of a forensic science expert witness from 1 to 6 in order of importance given the following criteria; university education, on the job training, certification, years of experience, working in an accredited laboratory and external training. Relationships between variables were analyzed using Pearson's coefficient because this tool is useful for small samples. Other statistical tools were considered, such as the Kappa Statistic for inter-agreement, where an analysis of the responses of jurors' comments on the expert witnesses and Kendall's tau-b, however these mathematical models were not applicable due to and the fact that the Likert's scale results are not continuous and therefore not normally distributed.

The frequency tables, pie charts and bar charts (in chapters 4 and 5) were generated in Excel by calculating the frequency of responses in relation to the total responses. These are descriptive statistics only and presented in order to provide a general picture of the dispersion of responses as well as the minimum and maximum responses.

2.11 Qualitative Data Validity

Qualitative data can sometimes be described as soft or largely intuitive and "qualitative researchers fall back on the three "I's"- insight, intuition, and impression" (Dey, 2003). To minimize any risk of interviewer bias, the themes and sub-themes which were extracted from the transcribed interviews, were revisited over a series of days and weeks. Sections of the phone interviews were revisited to ensure that the perspective of the juror including the tone and intonation was correctly interpreted. These techniques were important so that any interviewer biases could be identified and addressed and is

a technique in qualitative research known as bracketing. (Glesne and Peshkin, 1992). Bracketing is a system of setting aside the researcher's interpretation and places a heavy emphasis on the descriptions of the participants in the research.

Another technique available to qualitative researchers is to triangulate the data. This simply means seeking other sources to ensure the meaning being derived from the data is valid (Glesne and Peshkin, 1992). The qualitative data in this study were supported or triangulated with the quantitative data. A final step taken to ensure trustworthiness was to include longer quotations from the jurors, as much as possible, providing a richer description of what the juror reported experiencing facilitating great data upon which the trustworthiness of the interpretation could be assessed.

2.12 Overview of the Trials in this Study

All the trials used in this study were homicide trials that took place in Superior Courts in the State of Maine over a two year period. The experts were all called by the prosecution. As far as was logistically possible, all expert witnesses were directly observed giving evidence, however in two cases other expert witnesses who testified were not observed during the trial. The jurors were not asked about these experts, however, some jurors mentioned them during the phone interviews.

Each trial has been briefly summarized and a synopsis of the background and expertise of the expert witnesses who presented is outlined. Reflections on the observation of the witness and their apparent impact on the jury are also summarized in

Table 4. A more detailed description of the trials is contained in Appendix 2.

Table 4: Overview of the trials and the method of expert testimony

Trial Designation	Crime scene, victim and defendant information	Forensic science experts whose testimony was observed	Method of expert testimony Probabilities/ narrative/demonstrative aids
A	Female victim's body found in a vehicle. Victim died of gunshot wounds. Defendant was reported to have had an affair with the victim prior to the murder.	Forensic Trace Examiner	Narrative testimony, confirmed the presence of blood and semen on victim and at crime scene
		DNA Examiner	Conclusions based on numerical values of the random match probability (RMP) and (IP) inclusion probability
B	Female victim's body found in a wooded area. Defendant was an acquaintance of the victim.	Latent Print Examiner	Narrative testimony, fingerprint "identified" to defendant. PowerPoint used to illustrate the comparison and conclusion
		Medical Examiner	Narrative testimony, court chart used to describe location of injuries on the body
		Forensic Trace Examiner	Narrative testimony, described hairs, biological stains and fabric damage on victim's clothes
		DNA Examiner	Narrative testimony, no probabilities given to support the examiner's conclusions. Used terms such as "match" and "consistent with".
C	Female victim found in her own home. Cause of death was due to blunt force trauma. The house was set on fire after the murder. The defendant was a male family member.	Toolmark Examiner	Narrative testimony, used a demonstrative aid to illustrate the association between a wrench and a fracture on the victim's skull
		Fire Debris Examiner	Narrative testimony, described finding medium to heavy petroleum distillate products that were used to start the fire
		DNA Examiner	Narrative testimony, no probabilities given to support the examiner's conclusions. Used terms such as "match" and "consistent with".
		Latent Print Examiner	Narrative Testimony, court chart used to illustrate the comparison and conclusion
D & E	Male victim died of blunt force trauma/ strangulation found at the bottom of a river wrapped in a sheet and plastic bags. Two male defendants were friends of the victim.	Tire Impression/ Physical Match Examiner	Narrative testimony, PowerPoint used to illustrate plastic garbage bag physical match and torn bed sheets that physically matched
		Forensic Trace Examiner	Narrative testimony, confirmed the presence of blood on suspects' clothing and vehicle
		DNA Examiner	Narrative testimony, no probabilities given to support the examiner's conclusions. When the attorney stated that the blood on item 'X' belonged to the defendant or victim, the witness said "yes".

Trial Designation	Crime scene, victim and defendant information	Forensic science experts whose testimony was observed	Method of expert testimony Probabilities/ narrative/demonstrative aids
F	Female victim died of sharp force trauma and was found in her home. Defendant was a co-habiting intimate partner	Forensic Trace Examiner	Narrative testimony, described presumptive and confirmatory testing for blood
		DNA Examiner	Narrative testimony, no probabilities given to support the examiner's conclusions. Used terms such as "match" and "consistent with".
		Latent Print Examiner	Narrative testimony, explained how blood enhancement chemicals used at the crime scene work
G	Male victim found dead in his home. Cause of death was strangulation. Defendant was an acquaintance.	DNA Examiner	Conclusions based on numerical values of the random match probability (RMP) and (IP) inclusion probability
		Medical Examiner	Narrative testimony, court chart used to describe location of injuries on the body
H	Three victims (one female and two male) were found in a burned out vehicle. Cause of deaths were due to gunshot wounds. Defendant was a friend of one of the victims.	Fire Marshall 1	Narrative testimony, described searching the crime scene for evidence
		Fire Marshall 2	Narrative testimony, described the use of dogs to detect accelerants and determine origin and cause of the fire
		Fire Debris Examiner	Narrative testimony, described the detection of heavy petroleum distillate products which were used to start the fire
I	Male Victim found dead in his own home. Cause of death was sharp force trauma. Defendant was an acquaintance of the victim.	Toolmark/Footwear Examiner	Narrative testimony, used PowerPoint to illustrate the toolmark comparison and support the conclusions
		Forensic Trace Examiner	Narrative testimony, described the bloodstain patterns at the scene, used crime scene photographs to illustrate the conclusions
		DNA Examiner	Narrative testimony, no probabilities given to support the examiner's conclusions. Used terms such as "match" and "consistent with".

2.13 Conclusion

This chapter summarizes the trials and the expert witness testimony that the jurors observed. A trial is a dynamic event with so many players and stakeholders. The judge has an important role in keeping the trial running smoothly, admitting evidence that meets

admissibility standards and clarifying rules of law for the jury. The prosecuting attorneys are responsible for representing the victim and the State of Maine. They need to prove the defendant's guilt beyond a reasonable doubt. The defense attorneys need to cast enough doubt on the State's case that a jury is not able to find the defendant guilty beyond a reasonable doubt. The expert witnesses are there to speak for the evidence and to assist the jury with understand its scientific underpinning as well as its value and importance within the context of the framework of circumstances of the case. Finally, the jury must observe all the moving parts of the trial and use all of the information, learned through the verbal and non-verbal communication of the people at the trial, and later deliberate to come to a verdict.

CHAPTER 3: How Jurors Process and Interpret Evidence

3.1 Introduction

The jury trial process in the United States is based upon the assumption that the best way to deliver justice is to allow the opposing parties (prosecution and defense) to gather evidence and present it to a jury. The opposing lawyers in the case have to decide in advance of the trial what an uninformed jury would need to know to return a verdict favorable to them (Vidmar and Hans, 2007). In most other settings where important decisions need to be made, the best approach for decision makers would be to gather the facts they need themselves in order to come to a decision. Research into how juries make decisions is important to the legal system as it can highlight the best way to present evidence in court.

The American adversarial trial system, where the jury is passive and uninformed of the case to be presented, is based upon common law foundations. Great Britain and most of the former colonies of the British Empire, such as Australia, New Zealand, Bangladesh, India, Pakistan, South Africa, Canada (excluding Quebec) and Hong Kong follow a similar system (Reichel, 2002). In other countries, trials follow an inquisitorial or non-adversarial process. In these countries a judge or a panel of judges and lay people participate in the fact finding process by questioning experts, witnesses and sometimes even asking for particular tests or analyses to be completed. This type of trial process is followed in China and Japan and many of the continental European countries (Reichel, 2002).

Many studies have shown that the jury verdict is a product of juror preferences, expectations, inferences and stories (Diamond and Casper, 1992, Anapol, 1973, Ellison and Munro, 2010, Salerno and Diamond, 2010, Taylor and et al., 1979, Wood et al., 2011a). The adversarial criminal justice system relies on the judge to instruct the jury to set aside information, knowledge or biases they may have prior to hearing the case. However, research has found find that the judge's instructions to the jury are often ineffective (Devine et al., 2001) and that jurors decide cases based on their personal world view and information they learn during the trial (Baddeley and Parkinson, 2012, Hastie et al., 1983).

The models used by jury scholars to explain jury decision making can be broken up into two main groups, juror level models and jury level models.

3.1.1 Jury Level Models of Decision Making

A significant contribution to the body of literature on jury decision making was made by Davis' Social Decision Schemes (SDS) model. The SDS model can be used to predict final verdict outcomes based on initial juror preferences for a particular verdict. The SDS model includes an implied decision rule where the jurors come to some agreement given their divergent preferences. In a sense the SDS is a model that attempts to quantify the deliberation process (Davis, 1973).

An adaption to the SDS model came in the form of the Social Transition Scheme (STS) model. This model differs from the SDS in that it also takes into account how jurors' preferences for verdicts change over time. Jurors may favor one verdict initially and this may be different at various stages of the deliberation process. These shifts have been shown to be influenced by the duration of the deliberation process, how often juries take polls (votes) on verdicts and on the size of the jury (Davis et al., 1988, Kerr et al., 1982,

Bray and Kerr, 1979).

The Social Interaction Schemes (SIS) model takes the SDS and STS models a step further. The SDS and STS models are limited in that they assume the jurors only have one preferred verdict, guilty or not guilty. The SIS model incorporated a value for how certain a juror is in their verdict decision. In a case where only two verdict choice are available there could be four possible cognitive states, 1) certain-guilty, 2) uncertain-guilty, 3) uncertain- not guilty and 4) certain-not guilty. The SIS model has shown that jurors only move to an adjacent decision state over the course of deliberation (Stasser and Davis, 1981).

Other models such as DICE (named for the blindfolded Greek goddess who is used to represent justice, with a balance in one hand and a sword in the other- just in case) and later named JUS (meaning justice) made use of computers to model jury decision making (Devine, 2012). The DICE model is based on the SIS model, but rather than juror verdict preferences being assigned in a binary fashion, such as certain or uncertain, jurors are given a persuasion resistance value. This value is based on how likely the juror is to change their verdict preference if their decision was in the minority. The DICE model was later adapted to allow for situations where juries could deliver a verdict on a lesser charge. This newer model was named JUS (Penrod and Hastie, 1980).

The DISCUSS model (named as it incorporated jury discussions) is the most advanced jury decision model as it incorporates the information the jury hears at the trial as well as the what is discussed during the deliberation process. The model hinges on the theory that verdicts are a function of what the jurors have in their memory. The model

adjusts the predicted verdict by weighing up all the evidence discussed by the jury. Each time a piece of evidence is discussed this refreshes the memory of other jurors and in turn is predictive, according to this model, of the final verdict (Stasser, 1988).

Social Judgment Schemes (SJS) models were developed to accommodate situations when civil juries not only deliver a verdict but also have to decide on damages and monetary awards. These monetary awards are continuous in nature (not binary) and the model has shown that the awards can be predicted based on the sum of the jurors' individual preferences for a particular award (Davis et al., 1997). A summary of these jury level decision making models is presented in Table 5.

Table 5: Summary of Jury Decision Making Models

Model Name	**Model predicts jury verdict based on:**
Social Decision Scheme (SDS) Model	Initial (prior to trial) juror preferences for a particular verdict
Social Transition Scheme (STS) Model	The juror's initial preference for a particular verdict and how these preferences change during the deliberation process
Social Interaction Schemes (SIS) Model	The juror's initial preference for a particular verdict, how these preferences change during the deliberation process and how certain the juror is in his/her decision
DICE	The SIS model but measures certainty using a persuasion resistance value (how likely a juror would change their verdict if their verdict was in the minority)
JUS	DICE model but also allowed for situations where juries could deliver verdicts on lesser criminal charges
DICSUSS	The evidence which is discussed during the deliberation process. When evidence is discussed it refreshes the information in the mind of the jurors and its predictive of final verdicts
Social Judgement Schemes (SJS) model	Sum of the individual jurors' preferences for a particular monitory award (in civil cases).

By the mid-1980's interest in predicting verdicts waned and interest in how juries reached decisions peaked. The Story Model is now considered the best predictor of jury decision making and verdicts.

3.1.2 Juror Level Models of Decision Making

Mathematical models such as Bayesian, algebraic, stochastic introduced in the 1980's attempted to describe the complex process of evaluating scientific testimony and reaching a verdict (Hastie, 1993). The Bayesian model of juror decision-making specified that a verdict was based upon multiplication of the juror's initial probability belief in guilt or innocence with the value of the evidence presented at court expressed through a likelihood ratio (Devine, 2012). In this way the Bayesian model specifies that jurors, prior to the trial, have a sense of the defendant's guilt or innocence (prior odds). As the trial proceeds jurors combine this prior probability of guilt with the weight of the testimony they hear.

Algebraic models, in particular, basic linear models, work in much the same way. These model seek to predict juror decision making based on the juror's internal belief of the defendant's culpability which is modified during the course of the trial (Devine, 2012).

Stochastic models base juror decisions on probabilities. These models suggest that jurors process trial information sequentially and at some critical point the decision process stops. This could be due to juror fatigue or due to extremely compelling testimony. Testimony that is presented after this point will be added to the perceived weight of the evidence. The earlier the juror reaches this critical point, the more confident they will be

in their final verdict.

Most jury and juror models attempt to predict juror decision making in relation to final verdicts (Hastie et al., 1983). However, the focus of the present study was not that of the final decision but on trying to expose and examine how individual jurors evaluated the forensic science testimony. Three different theories relating to this central issue, (of assessing value placed on evidential information), were considered further.

3.2 The Strength of the Evidence

The strength of the evidence (SOE) is a measure of the quality and quantity of evidence presented in court and when the evidence presented is highly exculpatory or inculpatory (tends to exclude or include the defendant) this is a strong driver in the jury's decision making. (Devine et al., 2001, Smith and Bull, 2012, Smith et al., 2011). The strength of the evidence is a subjective determination made by the juror during the trial and finalized during the deliberations. Previous research has focused on the strength of eyewitness identification and polygraph evidence. These studies have found a substantial impact of eyewitness identification on verdicts (Devine et al., 2001). However, for example, when juries decide drunk driving cases the verdicts are closely tied to physical evidence such as field sobriety tests and blood alcohol contents (Snortum et al., 1990). The factors which influence how much weight a juror places on evidence are discussed in Chapter 4.

3.3 Central and Peripheral Processing of Scientific Evidence

Jurors in the adversarial trial system are presented with evidence by lay (civilian) witnesses, police and investigators as well as expert witnesses. Social science researchers have documented that there are two cognitive processes, central and peripheral, which jurors follow when they are interpreting information and evidence presented to them during the course of a trial (Jonakait, 2003). Central processing is where jurors are actively involved in processing the facts and opinions presented to them. The juror seeks to understand the evidence, evaluates its meaning and importance, and is actively engaged cognitively. Peripheral processing is when a juror is less interested in processing the information presented to him and does not participate in active cognition (Jonakait, 2003, Jonakait, 1991). It has been suggested that peripheral processing occurs when jurors are disinterested in the information or, of greater concern when it comes to 'scientific' testimony, they struggle to understand the evidence (Jonakait, 2003). When jurors engage in peripheral processing they tend to gloss over the evidence presented to them and rely on the credibility of the witness to judge the value of the evidence (Sanders, 1998).

Expert witnesses in the United States must qualify as an expert and be accepted by the Court (Champagne et al., 1991). This usually requires counsel for the side who called the witness to engage in a series of qualifying questions highlighting the expert's education, background, years of experience, certifications, and awards, memberships of professional organizations, publications and specialized training. If jurors do not understand the evidence, previous research has shown that they may follow a heuristic approach and give value (or excessive value) to evidence presented to them based upon

the education and qualifications of the expert rather than on the reliability of the evidence (Cutler and Hughes, 2001) and this is one of the consequences of peripheral processing where jurors fail to grasp the scientific matters presented. A second consequence of peripheral processing is that the juror gives the evidence no value or ignores the expert testimony (Diamond and Casper, 1992).

The literature suggests that, when the scientific content is understood, jurors tend to actively participate in evaluating and understanding the evidence and follow a central cognitive processing model. This is supported by numerous studies (Krauss and Sales, 2001, Taylor and et al., 1979, Hastie, 1993, Farrell and Givelber, 2010) and most clearly in the Arizona Jury project where jurors were allowed to ask questions of witnesses and where deliberations were recorded (Diamond et al., 2006). This study comprised of 50 civil trials where jurors were allowed submit questions to witnesses (with the judges' and attorneys' approval) during the trial. The deliberations were also video recorded. The video transcripts as well as the questions jurors asked of the witnesses showed that jurors actively participated in interpreting the evidence (Diamond et al., 2006).

3.4 The Story Model of Juror Decision-Making

The story model of juror decision making was introduced in the early 1980's as an alternative model to the mathematical models (Hastie et al., 1983). This model suggests that jurors decide the importance of evidence, and in turn verdicts, based on their world knowledge and also on the evidence presented at trial. The idea that the jury are neutral and passive decision makers is a legal fiction, according to Baddeley and Parkinson (Baddeley and Parkinson, 2012).

Figure 6 illustrates how the juror combines prior knowledge and trial information into a narrative. The story that appears to be the best fit will be the one that the juror will use when evaluating the importance of evidence and later delivering a verdict. When preparing for trial attorneys plan on what evidence they would like to present and how to paint a picture for the jury. The attorney chooses the evidence and witnesses to present at court that they feel will benefit their case (prosecution or defense). Evidence that does not support the case they are presenting to the jury is usually not presented. This means that not all the items collected at a crime scene, nor evidence collected as part of an investigation or individuals active in the investigation (police, detectives, crime laboratory scientists) or lay (civilian) witnesses will be presented at court. The nature of the "incomplete" picture leaves jurors with what they perceive as gaps in the story. The story model suggests that jurors in this situation will fill in the gaps in the case presented at trial with pieces that they feel fit to complete the whole story (Devine, 2012).

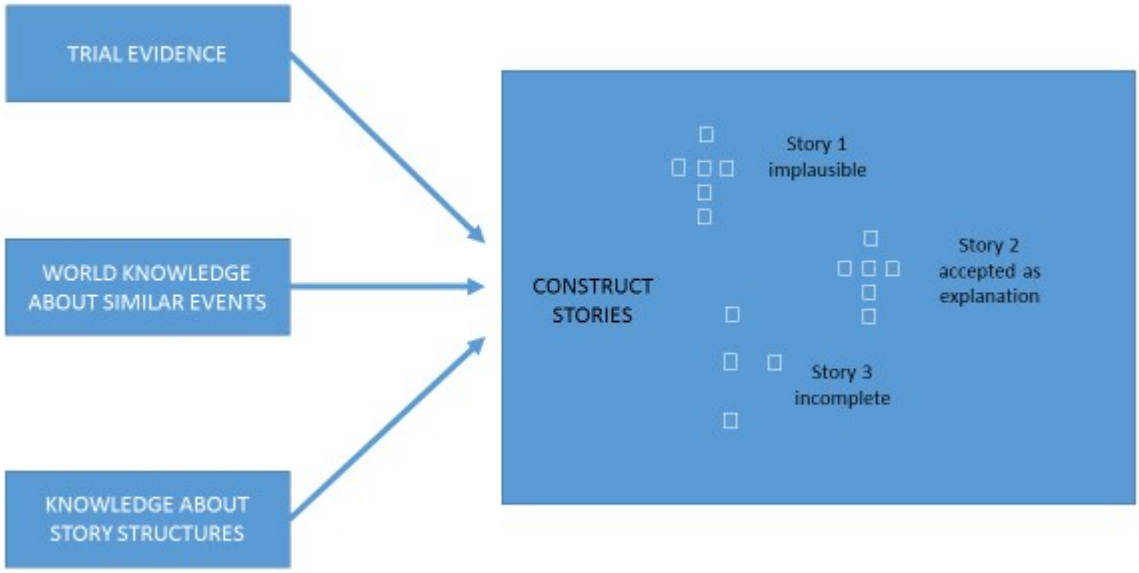

Figure 6: The Story Model of Juror Decision Making

3.5 Results and Discussion from Juror interviews

The strength and persuasiveness of forensic evidence in trial should not be underestimated and the strength of such evidence has the potential to have a profound effect of the jury. How jurors individually, and the jury collectively, evaluate this evidence then becomes a critical part of the final decision making process.

Determining which method of internal decision making is being utilized at any one time is complex and in reality it is highly likely that jurors will combine the different mechanisms together throughout the trial process. A range of questions were asked within the semi structured interviews of jurors to attempt to unmask the nature of their decision making given different evidence types presented to them and clear examples of all types of decision making processes were displayed across the jurors.

Strength of the Evidence

Jurors also placed more emphasis and weight on physical evidence when the expert witness testified to the strength of the association between the crime scene/ victim and the defendant. Jurors were asked how important different types of testimony were in their decision making.

In response to the question "Which was more impactful, the scientific evidence or the other evidence in the case, such as the police evidence, witness evidence?" (Question 14, Appendix 5). 73% of jurors interviewed stated that the scientific evidence was most important in their decision making, 20% stated that both the scientific evidence and other witness testimony were equally important and 7% said either police witnesses or lay

witnesses had the most impact on their decision making.

The importance of the forensic science evidence in juror decision making was heard in the jurors' comments when the scientific evidence strongly implicated the defendant. In case B there were numerous links (cell phone technology, social media connections, lay witness testimony, handwriting analysis, fingerprints and DNA) between the defendant and crime. The fingerprint expert in this case used a PowerPoint presentation to explain to the jury how she carried out her comparison of a palm print developed on a letter and a known palm print of the defendant. At the end of the presentation the expert said, *"The same person made these palm prints".* During the presentation of the palm print comparison a few of the jurors nodded their heads in agreement. In the same trial a DNA expert testified about DNA found on the victim's hat and DNA under the victim's fingernails. When explaining the DNA found on the hat the expert said, "*There was a thirteen locus match to (mentioned the defendant's name)"* and the chance of the DNA coming from someone else was *"less than 1 in 300 billion"*. The DNA under the victim's fingernails was analyzed using Y-STR testing. The DNA expert explained to the jury that this type of testing is helpful when there is a large proportion of female DNA and a smaller proportion of male DNA, as was the case with the fingernails. She stated that the DNA under the fingernails was a *"five locus profile consistent with (mentioned the defendant's name) or a male relative".*

In response to the interview question, "Which was more impactful for you in this case, the forensic science evidence or the other evidence, such as the police testimony or the other witnesses? Which had more of an impact on your decision making?" all of the jurors stated said that the forensic science evidence was very important in their decision-

making.

"Gregory" described how the scientific evidence impacted on him:

"That's all they do. That's all they study for, and it's what they do day in and day out. We went through the cell phone evidence and DNA evidence and fingerprints. Really, that was the main part that we used to make our decision."

"Gail" responded to the question by saying;

"The forensic science had all the proof that I needed, but it was interesting how they tracked the other evidence. To me, that was one of ... This is my third jury that I'd been on and that was the most impressive. I've never been on a murder trial, but the most impressive was the forensics."

"Gary" explained that the letter with the defendant's palm print and the cell phone tower evidence played a significant part in his decision making and verdict.

Researcher: *Which had more impact on your decision making, the scientific evidence of these expert witnesses, or other evidence in the case? The police evidence, or the other witnesses?*

"Gary": *It was probably the letters and the cell phone evidence.*

Researcher: *Okay, so the scientific evidence was more impactful, for you.*

"Gary": *I think so. Would you consider the cellphone to be science?*

Researcher: *Yes.*

"Gary": *Yeah, absolutely then. Definitely. Yeah, the letter itself he wrote was convincing to me, but the fact that the handwriting people said it was his handwriting, and the fingerprints on it, made it solid to me. I couldn't see how ... There was no reasonable doubt in my mind that he wrote that and that it had his palm print on it."*

Trials D and E were trials where two defendants were tried separately for the same homicide. The forensic science evidence showed a strong connection between the defendants and the crime. The victim had been found at the bottom of a stream wrapped in black garbage bags and parts of torn bed sheet had been used as ligatures. Two forensic scientists presented strong evidence implicating the defendants in the crime. In the following excerpt from the trial transcript the prosecuting attorney is suggesting to the jury that the victim was transported in the trunk of the defendant's car to the location where his body was found. A screwdriver was found in the vehicle, and swabs of the screw driver along with other swabs from the trunk and other areas of the car were collected.

Prosecutor: *Now, with respect to what is considered lab item one, a Volkswagen vehicle, did you receive …swabs from that vehicle?*

DNA Expert: *Yes, I did.*

Prosecutor: *And can you describe exactly what your received with respect to the Volkswagen?*

DNA Expert: *Yes, I received four swabs from that Volkswagen.*

****

Prosecutor: *Did you receive swabs from lab item 13?*

DNA Expert: *Yes, I did.*

Prosecutor: *And what did you receive [sic] with respect to that item?*

DNA Expert: *On item 13, that was a swab of the screwdriver… that was a 10 locus match to (victim's name)… When I talk about a 10 locus match to (victim's name) and the stats were 1 in 1.38 trillion*

people.

Prosecutor: *so that would be—*

DNA Examiner: *And that would be an identity match.*

A physical matching expert testified in these trials to positive associations between the garbage bag and torn bed sheets found with the victim and garbage bags and a torn bed sheet found in the defendants' home. The physical matching expert used a PowerPoint presentation to explain how plastic bags were manufactured and how she carried out her comparisons. The expert illustrated to the jury how the manufacturing process leaves features in the plastic that can be used to compare bags. Her conclusions were:

> *"Based on all those characteristics that I was showing you, the color, the size, the number of gussets, the heat seals, the pieces of contamination that carried over from one bag to the other, I was able to say this bag that was found in the river was at one time connected to the bag said to have come from (location victim was last seen alive)"*

This witness also presented photographs of the fabric that was used to bind the victim and a torn bed sheet from the location the victim was last seen. The fabric had a leaf pattern on it and the tears in the bed sheets and the leaf pattern were used to explain to the jury the positive association. The physical match expert concluded that:

> *"based on the overall characteristics that I was just showing you, the color, the size, and the random tears that were through the sheet and the ligatures, I was able to say that at one point those ligatures were attached to that sheet. So at one point that was one entire sheet."*

The forensic science evidence in these cases was strong (the testimony suggested a strong link between the defendant and the crime scene). Two jurors from these trials participated in the interviews. Both “Barry” and “Charlotte” felt the forensic science evidence played an important part in the jury decision making.

Researcher: *Which was more impactful for you, which had more of an impact, the scientific evidence in this case or the other evidence such as the police or the witness and I guess you mentioned a 911 call? Which had more impact on you?*

“Barry”: *I don't know. I guess there was one witness in particular that was the one that made the 911 call, that really stood out, and all the jurors thought that that was a valuable witness, but a lot of us went back to the scientific evidence, which we had in the deliberation room with us to look at and stuff. I think it's a mixture between. There was only one valuable witness not related to the forensic science evidence.*

In response to the same question “Charlotte” explained why the forensic science evidence was important to her.

Researcher: *Which had more of an impact, the scientific evidence or the other evidence in the case, such as the police or other witness evidence?*

“Charlotte”: *I think that I would place more value on the scientific evidence. I think for whatever reason I feel like it's more objective and you know any of the witnesses, the character witnesses that they had, are obviously more subjective and I guess it's hard to know if they're, if it's like true or, I guess I place more value on the validity of the scientific evidence.*

Researcher: *Do you think in this particular case the forensic science evidence was more powerful than the other evidence?*

“Charlotte”: *I do.*

The forensic evidence presented in trial H established that the fire that burned the bodies was arson. Traces of kerosene were detected. Unlike the other trials in this study, the strength of the forensic evidence (in linking the defendant to the crime) in trial H was weak (the testimony of the forensic science expert witnesses did not link the defendant to the crime). The four jurors who answered the interview question about the types of evidence which played a main role in decision making gave a range of answers. Some of the jurors relied on lay witnesses or the police, some on the forensic science evidence or reported finding all the evidence equally important. “Amy” said the forensic science evidence had the most impact on her. “Allison” stated;

> *“The eye witness and the other lay witnesses had the most impact on my decision.”*

“Alana” said that the forensic evidence did not play a significant part in the jury reaching a verdict.

Researcher: *Which was more impactful? The scientific evidence or the other evidence in the case, like the police evidence or the other witnesses. Which impacted your decision making most?*

Alana”: *In my opinion both. Only because I was interested in learning from the experts all the scientific ways things are done and how they came to that conclusion. But I also was I also felt very much that the friends that were there that night in the house and where they drove, was very important.*

Researcher: *Yes.*

“Alana”: *Oh course you have to assume they were telling the truth …but to me that was very important to put the timeline source. If we didn't have that timeline and we only had the forensic evidence? I don't think it would have been as easy to put together.”*

"Ann" also felt the forensic science evidence played a less important role in the jury decision making.

Researcher: *Which was more impactful, the scientific evidence in the case or the other evidence such as the police evidence or the other witnesses? Which had more of an impact on you, the science or the police and other witnesses?*

"Ann": *When you say science you mean all of the evidence that were lab analyzed, is that what you mean?*

Researcher: *Yes, exactly. The lab testimonies. There were GCMS results on the accelerants, and things like that.*

"Ann": *Right, and the blood levels, the drugs, and stuff like that. The question is which had more validity for me, is that what you're asking?*

Researcher: *Yes, the question was which was more impactful on your decision making? Which had more of an impact. I'm trying to figure out how important the scientific evidence was in your opinion. Was the police evidence, the police testimony or other witnesses' testimony more important?*

"Ann": *I think for me, it was pretty much equal across the board. I think that's partly I just didn't give anything more weight than another, sort of taking it in a holistic way. I would say neither was more impactful than the other.*

If trial H was excluded from the calculations (as there was no forensic science evidence linking the defendant to the crime) jurors reported scientific evidence having a greater impact on decision making 83% of the time and 17% of the time for police and lay witnesses. When the forensic scientists testified to a strong link (either presenting their evidence statistically or through subjective opinion) between the defendant and the victim/crime scene, jurors rated the scientific testimony as having a greater impact than

police or lay witness testimony on their decision-making. This trend has also been reported elsewhere (Lieberman et al., 2008, Garrett and Neufeld, 2009).

During the observed trials some expert witnesses laid the ground for subsequent witnesses, for example some experts testified to serological examinations of biological samples, such as presumptive testing for blood and semen and a subsequent witness testified to who was the likely source of the DNA sample. This is not an uncommon practice in complex cases such as homicides.

Jurors were asked "how important the testimony of the forensic scientists were in their decision making" (Appendix 4, question 29-31). Twenty nine jurors responded and rated of 23 expert witnesses (average of 3.7 witnesses per trial) over the nine trials studied and the overall results are presented in Figure 7.

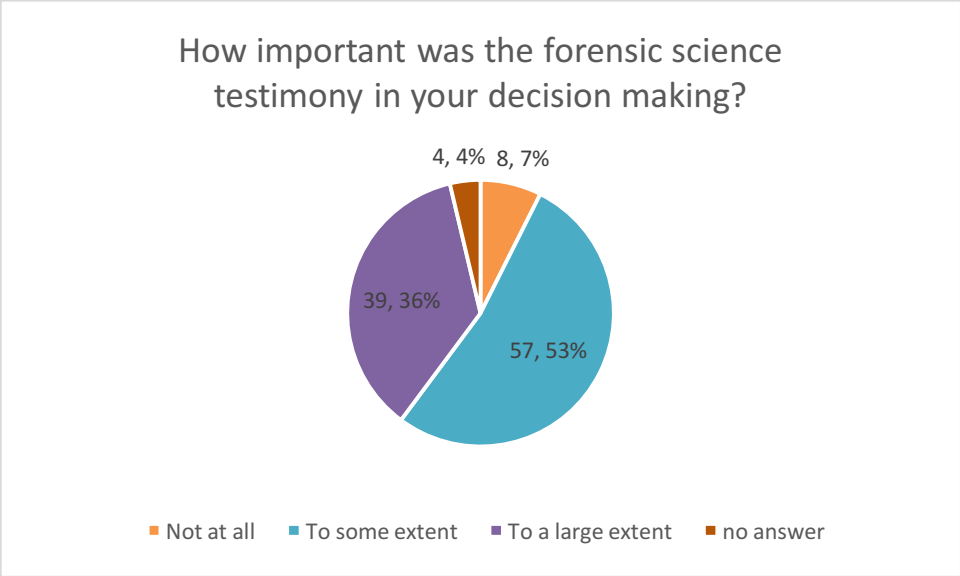

Figure 7: The importance of the forensic science testimony in juror decision making

The data for specific evidence types is presented in table 6 below.

Table 6 : Summary of responses relating to individual evidence types for their importance in the decision making of the jury

Evidence type	Number of jurors	Number of forensic science witnesses	Importance of evidence in decision making		
			High	Some	None
DNA	23*	7	10 (44%)	12 (52%)	0
Toolmarks and Physical Match	14*	4	6 (43%)	7 (50%)	0
Fingerprints	11*	3	5 (45%)	5 (46%)	0
Serology and Trace	22*	6	9 (41%)	12 (55%)	0
Medical evidence	9*	3	5 (56%)	4 (44%)	0
Fire investigation and Fire Debris	14	4	1 (7%)	9 (64%)	4 (29%)
Footwear/tiretracks	10	3	4 (40%)	5 (50%)	1 (10%)

* In each of these categories one juror did not answer the survey question

All of the DNA expert witnesses in this study testified at each of the trials that the defendants' DNA linked them to the victim or the crime scene. The toolmark and physical matching evidence presented at the trials gave a very strong link (according to the expert's opinion testimony) between the defendant and the victim/ crime scene. In two of the trials the fingerprint testimony linked the defendant to the victim/ crime scene and in one the experts reported not finding fingerprints on key pieces of evidence. For the serology and trace evidence, the expert witnesses testified to how they performed presumptive chemical tests for the presence of blood and semen. When these tests were positive, a swab or a cutting was made, and DNA testing was performed by another scientist. The trace evidence testimony also included fiber and hair evidence as well as fabric damage. The medical examiners testified to the manner and cause of death of the victim in the homicides studied. Testimony included gunshot wounds, sharp force and blunt force trauma, burning, stages of decomposition as well as toxicology of the victims.

The fire scenes associated with the homicides in this study were attempts by the perpetrator to destroy evidence. The testimony of these experts confirmed the use of an accelerant (such as kerosene and gasoline) but did not directly link the defendant to the homicide. The footwear and tire impression experts in these homicide trials testified to associations based on class characteristics between impressions at the crime scene and the defendant/co-defendant. In these cases the evidence did not confirm the defendant/co-defendant's presence at the crime scene but linked (in the opinion of the witness) a shoe or tire of the same pattern to the crime scene.

These results demonstrated support for the theory that the jurors' decision making is based on the percieved 'strength' of the evidence where this refers to associations or otherwise being asserted by the witness based on the forensic evidence between the defendant and the victim or crime scenes. Where expert testimony indicated a weak association (class characteristics in the footwear and tire evidence for example) or evidence that did not provide a direct link to the defendant (fire scene examination and fire debris conclusions for example), jurors placed less weight on these types of evidence in their decision making. When experts testified to a strong association (fingerprint evidence, identity statement for DNA comparisons, and positive conclusion in a physical match as examples), the jurors placed more weight on this and this testimony had more influence on their overall decision making.

Central and peripheral processing

The interview question, "What do you need to know to be able to evaluate the importance of a piece of evidence?" (Appendix 5, Question 7) in particular elicited

responses from jurors that clearly showed they actively processed the information presented to them at trial and did not solely rely on the testimony of the witness or the explanation of the attorney. All the jurors described trying to evaluate the evidence given their understanding of the expert testimony.

One of the jurors in the study, "Justin" explained the link between central processing, understanding the evidence appropriately and accurately placing the correct weight on the evidence:

> *"It must be the doctor who came in and explained the knife wounds. He showed the shards in detail. More than just his words, he showed the pictures and explained it, so I didn't have any problem with accepting what he was saying."*

Many of the jurors interviewed described having no issues understanding the expert forensic science testimony. Some of the jurors reported that their understanding of evidence came from the way (verbal communication and visual aids) the experts described their examinations and conclusions. One juror, "Amy", described how an expert in fire investigation repeated for each evidence item the step by step process of how the items are collected and examined at the crime scene. She felt this helped her understand the process:

> *"It allowed the jurors to hear the same thing over and over again. It was like mastering it. Again, it was helpful, and then it was also able to be taken off the table, meaning we felt like everything they did was solid, and they explained it well, and we understood why they were doing it."*

Some jurors went one step further and needed to be able to evaluate the scientific

evidence themselves to be able to establish the weight or importance and fully accept the expert witness' testimony. In some cases there was a strong desire to be taught the science as part of the trial. "Grace" described being able to rely upon expert testimony when she understood it:

> *"I was able to trust the information that was provided to me or not trust some of the other information that was provided to me, given my education"*.

In this instance the juror's strong need to fully comprehend testimony about cell phone tower technology led her to change her trust in (weight of) the evidence. In instances such as this a juror with a strong affinity for central processing may be forced into peripheral processing and then under value the expert testimony. "Grace" stated:

> *"There were moments where they …went a little too fast for lay people that I didn't understand the technology. I wanted to scientifically believe that they really could pin point his location".*

As much as the jurors in this research study described their active participation in evaluating and putting weight on the expert testimony, some also described not understanding the evidence and engaging in peripheral processing. Jurors described peripheral processing in relation to understanding how chemical presumptive tests used to test for the presence of blood or semen work, how firearms function, DNA evidence and their associated statistics as well as cell phone tower technology. In relation to genetics testimony "Charlotte" stated:

> *"…with not being a scientist in the natural sciences, I just kind of defer to the judgment of the expert witness. I don't know anything about what they were taking*

about so I just assume that what they're saying is right".

Also in relation to DNA testimony "Justin" reported:

"There is a whole level of inherent trust that you tend to apply to someone who comes forward that is brought to the case from the government. I found myself doing that…I had to jump to conclusions on what she (DNA expert) said there was clear DNA…on three pairs of pants".

Some jurors also indicated that they used their background, education and world knowledge to evaluate the reliability and importance of evidence as well as expert witness credibility. When speaking about the forensic science evidence most jurors had very little prior understanding of the science and were depending on the expert witness to explain the meaning of the evidence to them. "Amy" commented on her lack of knowledge of firearms and expressed that she struggled to understand the value of the evidence:

"We had several men on the team who knew a lot about forensics, or knew a lot about guns, who again, for them, when we were going through the forensics and had the expert witnesses regarding the guns, they knew all the foundational stuff with that. For me, I was learning stock and triggers and how you hold it, and so I was learning more about that piece… and which bullet was in which person, and who had fired that bullet, which gun it came from … and I didn't get it until the very, very end during deliberation, and I think that's way too late."

Comments such as these were seen across the different forensic science evidence types and highlighted the difference the between the juror level world view and the group or jury level world view. In cases with complex evidence or scenarios it is important for the attorney presenting the evidence and the expert testifying to ensure the forensic

science evidence is clear for all jurors, and to avoid relying on the world view of the group (jury).

Story model

In response to interview questions about how they know the importance of an item of evidence in a case (Appendix 4, Question 7), jurors stated that they consider the forensic evidence in light of all the information and evidence presented to them. The importance is related to how the evidence fits with a story in their mind. “Ann” described how she knew if a piece of forensic evidence was important in the case:

> *“I guess that other pieces of evidence collaborate with that piece. In other words, it's not just a standalone piece but other parts affirm that that piece is credible evidence. It's not just that it's one piece standing out, but that they're all sort of supporting each other.”*

Jurors rely on the trial process to understand the importance of evidence. How that item or testimony fits with the story is important to them. They actively try to put a value on the forensic testimony by themselves prior to deliberation and as a group during deliberation. Placing the items of evidence in a story with a timeline “Amy” stated:

> *“I had to start trying to figure out a timeline, and figuring out where they were, and where was this, and does this make sense, and does that fit here?”*

Jurors struggled to make sense of, and determine the value of evidence found in a vehicle in one homicide case. Timelines that appear implausible can lead to a weakening of the value of the forensic science evidence in some cases. “Dorothy” described this when

she said:

> *"the whole idea that he could drive the car in the middle of winter up to that parking lot and walk back to the house just seemed a little bit of a stretch. Clean up everything and all that stuff, I don't know, I didn't quite believe that. I wish they could have proven that a little bit more clearly."*

In another case "Gary" mentioned:

> *"Why was that guy there? Why was that vehicle there? If we can prove that vehicle there at a certain time, then what would that say in relation to what happened?"*

In other instances jurors described difficulty believing the story of the circumstances surrounding events that happened after a homicide. In a case where items of evidence which had forensic value to the case were found in a location a distance from the decedent, "Gail" said:

> *"Why did the man take the clothes off? I realize why he took them off the body, but what I didn't understand is why he didn't just throw them away, why he brought them back to the scene where he kidnapped her. That was the only thing I just couldn't wrap my head around. Why would someone do that?"*

3.6 Limitations:

The limitations of these findings are that they are based on a small sample size. 144 jurors were contacted and 29 jurors filled out the survey and of these, 20 participated in the phone interviews giving a response rate of 20% and 14% respectively.

The response rate per trial ranged from 1 juror to 5 jurors and for one trial there

were no responses. The circumstances of the homicides, how the trials progressed, how the expert witnesses testified and how the jurors viewed the testimony are unique and independent events. In order to determine if patterns existed in the data, juror responses to expert evidence over all the trials were combined.

Researcher bias must also be considered and when examining the quantitative data it was important to establish if the jurors understood the evidence and placed appropriate weight on it.

Lastly, this research was carried out in Maine and only homicide trials were part of the study. This narrow scope may influence how these finding can be applied to other jurisdictions and crime types.

3.7 Conclusions

Critics of the jury process in the United States often suggest that juries are incompetent and fail to understand scientific evidence (Hans et al., 1986, Ivkovic, 2003). Defenders of the jury system point to research that shows juries, as a group, do place the appropriate weight on scientific testimony and make better decisions using that scientific evidence, than a single judge (Eisenberg et al., 2005, Hans, 2007, Jonakait, 2003).

Previous research suggests that jury decision making and verdicts are based on the strength of the evidence (Devine, 2012). This research points to the fact that forensic science evidence is certainly important to jurors in their decision making process. Jurors

evaluate the weight of the evidence and rely heavily on forensic science testimony that establishes a strong positive connection between the defendant and the victim or the crime scene. Jurors place less weight on weaker connections between the defendant and the evidence at the crime scene (for example class characteristics association) and when the forensic science evidence explained the condition of evidence at the scene but did not establish a link to the defendant (for example evidence that confirmed the presence of accelerants in a suspected arson).

This research supports the previous literature which suggests jurors take their role seriously and do their best to cognitively engage with the scientific evidence presented to them. Jurors explained their understanding of the forensic evidence pressented in court and for the most part it was accurate, and the weight appropriate to the testimony proffered was placed on the evidence. Previous research has shown that jurors participate in central processing unless they do not understand the evidence (Diamond and Casper, 1992, Jonakait, 2003). In this research study it was found that some jurors struggled with testimony about cell phones and cell phone tower technology, about how DNA matches were arrived at, with how firearms functioned and how chemical presumptive tests for blood and semen worked. When jurors did not understand the evidence they engaged in peripheral processing and relied upon the expert witnesses' credibility to determine the value of the evidence.

Jurors bring with them to the trial and the deliberation process their own knowledge and combine this with the information presented to them to form a story. Jurors will fill in gaps in the testimony presented with what they believe to be the most likely chain of events that lead up to the crime, how the crime was committed and the

events after the crime. In this research it was found that the story model of juror decision making closely follows how jurors process and give weight to the evidence presented at the trial.

It is clear that forensic science testimony is very important to juror decision making. This puts a heavy burden on expert witnesses, attorneys and judges to ensure that only scientifically vallid evidence is placed before the jury and that the evidence is presented clearly and completely in order for jurors to evaluate and interpret it. The stronger the association and connecttion between the forensic science evidence on the victim or crime scene and the defendant the more this evidence will be used by jurors in their decision making processes related to the case.

CHAPTER 4: The Witnesses and the Evidence: Credibility, Reliability and Impact on Decision-Making

4.1 Introduction

Research on how forensic science evidence directly influences jury decision making is sparse (Devine et al., 2001). The studies that have been published cover polygraph tests, serology and DNA testing (Devine, 2012, Hans et al., 2011, Schklar and Diamond, 1999, Saks and Wissler, 1984). These studies suggest that scientific testimony has a modest effect on jurors (Roesch and Zapf, 1999) and that jury verdicts have a "mild slant" towards the expert testimony. Other variables related to scientific testimony have been shown to have an effect, for example, unopposed testimony appears to have a "modest" influence on juror decisions. Previous work has suggested that even with defense rebuttal, the initial testimony was not dampened, potentially providing prosecutors with an advantage. This fits with the theory which that what is stated first has the most influence on the recipient (Roesch and Zapf, 1999).

Further, the content of the scientific testimony has an influence on jury decision making. It has been found that scientific evidence directly related to facts of the case has more influence on juries than general scientific testimony describing underlying scientific ideas (Devine, 2012) and this has been suggested in the results section in Chapter 3.

One important research study that has explored how forensic science testimony influences juror decision making comes from the Capital Jury Project (CJP) (Bowers, 1994, Carpenter, 2011). The CJP which started in 1991 and continues today, is a collaborative

research study carried out by a series of universities who interview jurors after death penalty sentences. This research project studied the perceptions jurors had of professional expert witnesses, lay expert witnesses and family/friends (Sundby, 1997). It has been found from the CJP and other studies that jurors under-value (place less weight on) DNA evidence than the statistics presented in that evidence would suggest in terms of the evidential weight of the DNA evidence in a given case (Nance and Morris, 2005, Koehler et al., 1994), however a more recent study indicated the opposite and that jurors placed excessive weight on DNA testimony (Thompson and Newman, 2015). A study on how jurors place weight on fingerprint testimony found a "widespread agreement" among mock jurors (Garrett and Mitchell, 2013). Additional research needs to focus on the other areas of forensic science, such as fire debris evidence, footwear impressions and bullet comparisons, to name a few.

4.2 The Jurors' Perceptions of the Expert Witnesses

During the study, a set of questions was asked which specifically related to the jurors' perception of the expert witnesses. These included both survey and interview questions. The purpose was to elucidate responses which would provide information relating to the jurors' perception of the expert, their expertise and experience and how this might influence their decision making in relation to the specific case. The relevant questions are in appendix 5 (questions 3, 4 6, 7 9 and 10).

4.2.1 Jurors' Definition of an Expert Witness

Twenty two jurors were asked to define an expert witness in their own words. The jurors defined an expert witness in multiple ways but many definitions contained

common descriptors such as "*knowledgeable, specialized*" and as someone who had 'received training'. "Justin" described an expert witness as:

> *"Somebody …who has training. To me it's important to have a college background, scientific background. If you're going to be analyzing data, you need to understand statistics and also processes and knowing what procedures are and following them. Just because somebody takes a six weeks course doesn't really to me qualify them as an expert."*

In "Harold's" words an expert is:

> *"somebody by virtue of their training and experience that has a high level of expertise in a particular area."*

"Martin" had a similar description:

> *"I would classify an expert witness as an individual with both experience and education specific to a field to offer expert testimony."*

A few jurors indicated that a certain amount of experience was necessary to truly be considered an expert witness.

"Alana" stated:

> *"I truly believe you have to be at least five years on the job"*

and "Gail" also described experience as important*:*

"somebody with a lot of experience, has been working in it for quite a while".

For some jurors credentials and certifications were an important part of the definition of an expert witness. "Gillian" expected experts to have:

"licenses or certifications pertaining to that field"

and "Matthew" said experts should have:

"credentials or certificates of competency".

"Barry" described an expert in terms of a Certified Public Accountant (CPA) in a hypothetical case involving fraud:

"*An expert witness in my mind, I think it's like a professional in that . If there was, tax evasion or …if it was something finance related, if you had a CPA, I feel (would be) an expert in that field".*

4.2.2 Qualifications, Training and Certifications of an Expert Witness

The survey asked jurors (n=25) one general question (Appendix 4, Question 12) about expert witnesses and then specific questions (Appendix 4, Questions 13, 16, 17, 18, 21, 22, 25, 28, 29 and 30) about the each of the expert witnesses who presented evidence. The general question asked jurors to rate, in order of importance the qualifications and background criteria for an expert witness. The results combined across all 25 jurors are presented in Table 7 and Figure 8.

Table 7: Importance of qualifications in an expert witness

	Rank					
	Most important					Least important
	1	2	3	4	5	6
University Education	7	7	5	1	0	5
On the Job Training	0	11	4	4	3	3
Certifications	2	7	5	6	3	2
Years of Experience	15	0	5	4	1	0
External training	0	0	2	7	6	10
Working in an accredited lab	1	0	4	4	11	5

Rank: 1= Most Important, 6= least important (red = below 25%; orange= >28%; green=>60%)

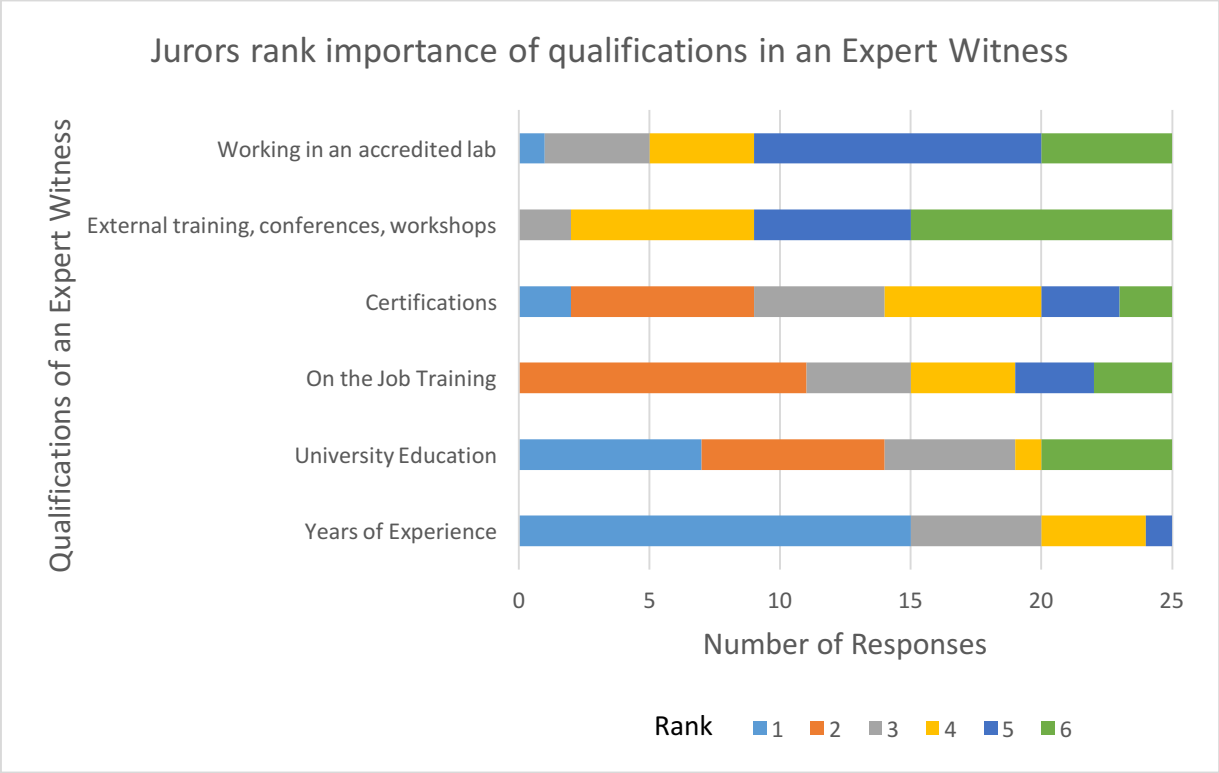

Figure 8: Jurors' interpretation of the importance of qualifications in an expert witness

Jurors rated university education, on the job training, certifications and years of experience as the most important qualifications in an expert witness (Figure 8). There was no one qualification that all jurors found important. University education was ranked in the top 3 by 76% of jurors, on the job training was ranked in the top 3 by 60% of the jurors

and years of experience was ranked in the top 3 by 80% of the jurors. Less important to the jurors was if the expert worked in an accredited lab or the expert's external training. 80% of jurors ranked "working in an accredited lab" in the lower three positions and 92% of jurors ranked external training in the lower 3 positions. The data are illustrated in Table 8.

Table 8: Importance of qualifications in an expert witness

	Rank in importance Most Least		
	1&2	**3&4**	**5&6**
University Education	14 (56%)	6 (24%)	5 (20%)
On the Job Training	11 (44%)	8 (32%)	6 (24%)
Certifications	9 (36%)	11 (44%)	5 (20%)
Years of Experience	15 (60%)	9 (36%)	1 (4%)
Working in an accredited lab	1(4%)	8(32%)	16(64%)
External training	0	9 (36%)	16 (64%)

(red = below 25%; orange= >30%; green =>60%)

These data may have been influenced by the jurors' perceptions of higher education, where over 80% ranked experience and education high irrespective of whether they themselves had attained education beyond the high school level.

A Pearson correlation coefficient was calculated for university education and years of experience. There is a statistically significant inverse correlation between a juror's ranking of university education and their ranking of years of experience ($r = -.547$, $N=25$, $P=.01$). Jurors who tended to rank university education high also tended to rank years of experience low, and vice versa. This data is illustrated in Table 9 and Figure 9.

Table 9: Correlations of the ranking by Jurors of an expert witnesses qualifications

	University Education	OJT	Certifications	Experience	Working in an accredited lab	External Training: Conferences/ workshops
University Education	1	-.299	-.051	-.522**	-.196	.163
OJT	-.299	1	-.511**	-.060	-.127	-.155
Certifications	-.051	-.511**	1	-.189	-.166	-.078
Experience	-.552**	-.060	-.189	1	-.231	.300
Working in an accredited lab	-.196	-.127	-.166	-.231	1	-.237
External training: conferences/ workshops	.163	-.155	-.078	-.300	-.237	1

**Highlighted areas indicate correlations which are significant at the 0.01 level (2-tailed)

The same was true for the correlation between on the job training and certifications (r = -.511, N = 25, P = 0.01). Jurors who ranked on the job training high tended to rank certifications low. This appears to indicate that jurors either put weight on formal education of the expert witnesses, such as certifications and university education and value on the job training and years of experience less or vice versa. This may be due to the juror's own experience and whether they had a formal education or learned their jobs skills. The small sample size is a limitation that needs to be considered with these observations.

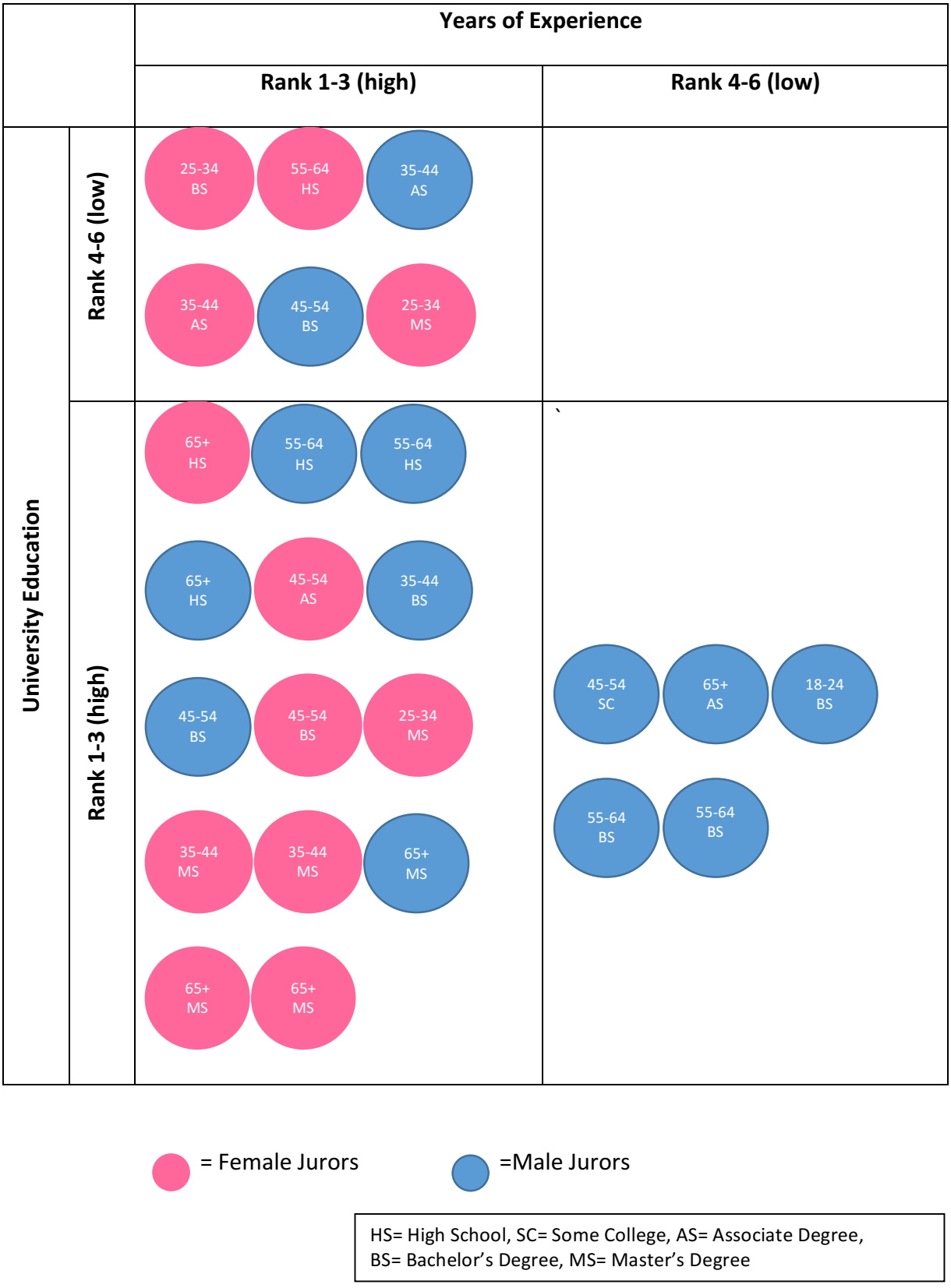

Figure 9: Comparison of gender, age and education level of Jurors within the ranked categories of years of experience and university education.

The 22 jurors who were interviewed were asked, “Which is more important in an expert witness, qualifications, such as education or certifications or years of experience?” (Appendix 5, Question 4). The majority of jurors, 63%, stated that years of experience was more important in an expert witness than qualifications (Figure 10) supporting the data derived from the paper survey.

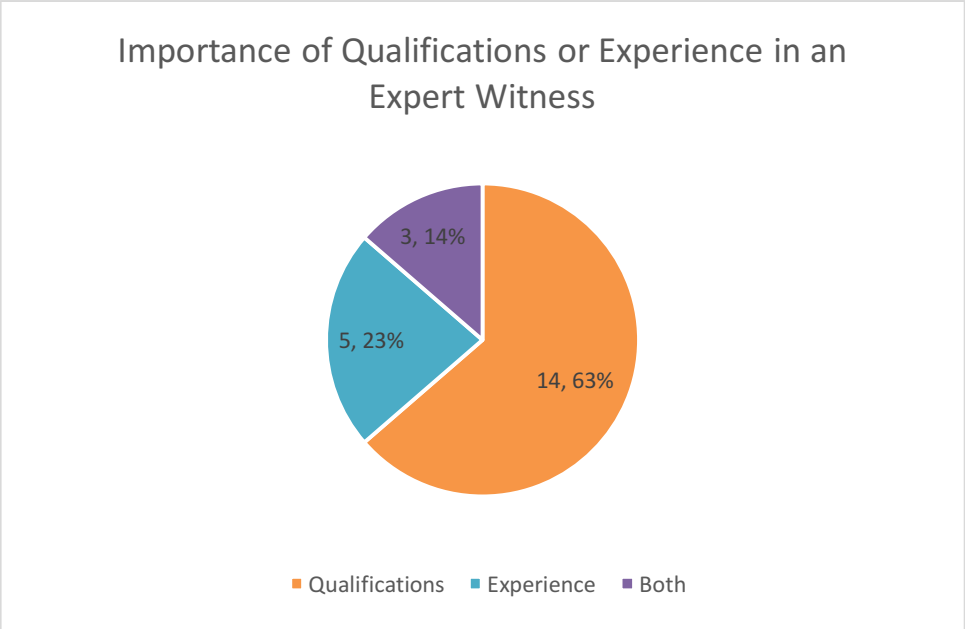

Figure 10: Jurors’ evaluation of the importance of formal qualifications vs. years of experience

Jurors thought experience was the most important factor in an expert witness and explained during the interviews that although education and certifications are important for a forensic scientist, they felt that it was the application of this knowledge (through job experience) that led to expertise. “Amy” stated:

> *“I think there are some people who can get many certifications and take many courses and classes, but they can't actually apply it and have never applied it. I think there are people who have developed significant experience in the subject matter from just seeing, doing, being around it, being around other people”.*

Jurors described the value of experience in terms of the variety of evidence types a forensic scientist might be called on to analyze. “Amy” said that a person with experience would be better than a person with only qualifications when the evidence was complex or outside of what might be expected:

> *“(forensic scientists) having a sense of what the norm would be and things that would not necessarily be the norm.”*

“Dana” described the benefit of experience to the forensic scientist as:

> *“Highly qualified people do not necessarily have the vast experience to know what is average or extraordinary or usual”*.

“Dorothy” felt experience allowed the scientist a range of approaches when examining evidence:

> *“because every case is a little bit different, and I think that there's more flexibility in experience. (Evidence is) not as standard as stuff you get from the textbook”.*

Some of the jurors related the value of experience back to their own professions and job experience. There was an understanding among jurors that forensic science as a profession cannot be learned solely from books. “Lloyd” said;

> *“I'm an accountant. When I started accounting, even though I had learned all this stuff, actually seeing it in practice the first time …things are a little different than what you see in the book. You have to be able to recognize that. I would say that experience is probably, with the proper qualifications or the training, experience would be more important than the qualifications”.*

"Larry" explained the value of experience by relating it to a life event:

"I would say years of experience, and here's a good example. My wife was seeing a medical specialist and saw him for several years, and he had qualifications. He had certificates and he had fancy diplomas, and he lost his medical license because he didn't know what … he was doing. I would much rather, someone in a very serious professional field, I would much rather have someone that had a lot of experience and was competent."

The challenge for new forensic scientists in qualifying as an expert in court will be to describe their qualifications and also how they have learned the discipline through supervised casework or other internal training. "Larry" explained:

"For example, if someone were soon out of college, I don't know that they're going to be an expert witness but they do have the necessary education to get them there. Some of those things go hand in hand. Experience is very important but their upbringing or background enters into it as well. I would think that a journeyman so to speak would be working with an expert witness and would become an expert witness over time based on both education and then experience in the career."

A few jurors described the connection between experience and qualifications. To gain experience you need qualifications and to gain credentials you need experience. Certification in many of the different forensic science disciplines requires the scientist to have a certain minimum number of years of experience, so it is true that credentials such as certifications require experience as well. "Ann" said:

"it's hard for me to almost differentiate them because my assumption would be if they're credentialed in anyway, that that process means that they do have experience. I guess I would say credentials, assuming that that comes along with

some kind of procedure, or protocol, before they are credentialed that would involve experience."

"Gillian" also felt that experience and qualifications went hand-in-hand:

"I think it varies because, well, personally I say both in order gain the qualifications you have to have the experience".

For the most part the jurors valued both experience and the formal qualifications of the expert witnesses. "Grace" described why she thought both education and experience were important in an expert:

"I think both are important but a person wouldn't be reliable if they didn't have the proper qualifications and I think that's just the standardized way of demonstrating someone's expertise in the field is usually if they have a certain credential there. They're passing the test but they're also certified at that level by having years of experience. Someone doesn't just pass the test and become a Medical Examiner. They're supervised and they're given feedback. To me, the qualification supersede experience because it include experience."

When speaking of the importance of qualifications jurors focused on the value of foundational knowledge needed by a forensic scientist that the jurors described should be based on education and other credentials. "Justin" described expertise in terms of his own experience as an engineer:

"I guess for me qualifications. I'm an engineer and the only way that I could get my professional engineering license was by having a certain number of years of experience. Then I'd have to have other professional engineers sign off that they've observed me and witnessed my performance. I'd have to have a certain amount of

education in order to pass. I think qualifications is higher than experience".

4.3 How Credible is the Expert Witness?

The credibility of an expert witness can be defined as how persuasive that person is when they give testimony (Ivkovic, 2003, Pope et al., 2006). Pope suggests that credibility is related to the expert's "authoritativeness, character, competence, attractiveness and expertness" (Pope et al., 2006). Understanding how jurors interpret witness credibility is important as it has been shown to influence perceptions of evidence reliability and verdicts (Cramer et al., 2009, Ivkovic, 2003)

Jurors were asked in the paper survey to rate the credibility, in their view, of the expert witnesses that they watched during the trial. The jurors who participated in the follow-up phone interviews were asked to describe how they determined if an expert witness was credible. Jurors rated all the expert witnesses they watched as being credible. Figure 11 shows the breakdown of the evaluation of credibility across all of the expert witnesses. 99% of the jurors felt that the expert witnesses were either very credible (54%) or Credible (45%).

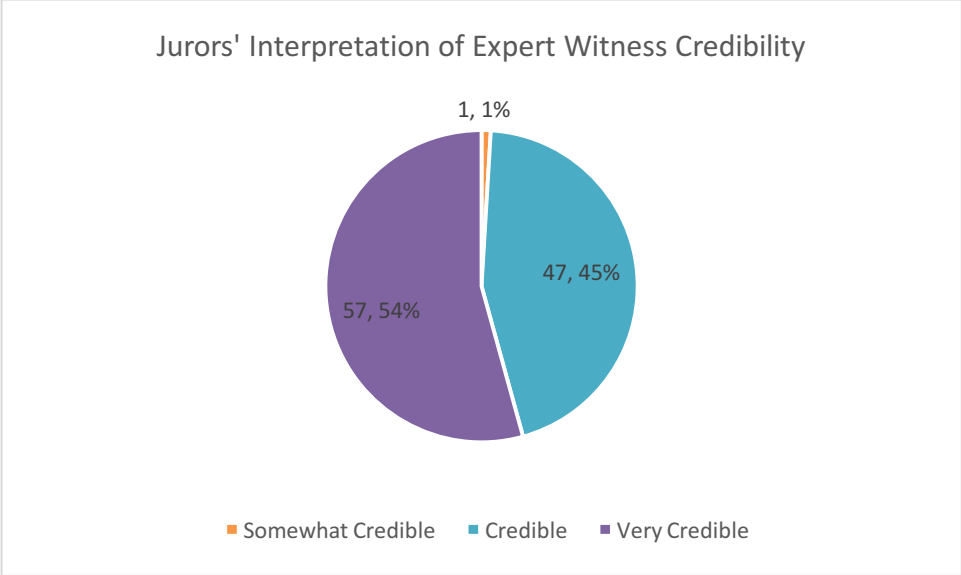

Figure 11: How jurors rated credibility of all expert witnesses who testified at their trial

4.3.1 Qualifications

Jurors described their view of the expert witnesses' credibility based on the experts' qualifications. Each time an expert witness testifies in the State of Maine they answer questions asked by the attorney who called them. This gives the Court an opportunity to decide if the individual is an expert for the purposes of the trial. This process gave credibility to the expert witnesses. "Grace" explained:

> *"I believe that they were credible when they went through and introduced their background. They wouldn't just come up and start answering questions. They would begin by ... Well, actually it was from a question. The first question would be describing your background or qualifications or credentials. When they described that aspect, that's what sold me in trusting what they had to say."*

"Lloyd" stated how he determined credibility of an expert witness as:

> *"the lawyers explain that, their background and their experience. We basically relied on that"*.

"Barry" specifically commented on the testimony of the medical examiner:

"I remember specifically there was one guy, and I believe he was a doctor from the Maine State Crime Lab. The wounds that were inflicted to the victim, weren't self-inflicted…, I guess knowing he's a doctor, he had ... He gave his qualifications. He'd been working for the Maine State Crime Lab for a long time. I don't remember exact years, but I think knowing he obviously has hundreds of hours, I think that those are all important."*

*The medical examiner works for the Maine Attorney General's Office, not the Crime Laboratory.

4.3.2 Confidence and Demeanor

The most common method jurors reported using to evaluate an expert witness' credibility was based on the expert's demeanor and their confidence on the witness stand. "Gillian" described how she based credibility on:

"their knowledge of fields and their confidence on the stand".

"Gary" described the credibility in the same trial as:

"demeanor, I guess, to a degree. Good old fashioned judge of character. Sometimes the defense tries to get under their (expert witnesses) skin, so to speak, and you can see how people react, and you can see a seasoned veteran sometimes by that. I saw that first hand at the …case."

"Alana" commented on both prosecution and defense experts:

"*You could tell the ones that were trying to just spin a line and the ones that were the honest ones and that were real sincere about their job and or the ones that were trying to avoid [sic] the answering (the question)."*

"Justin" described how confidence and credibility were connected to how well an expert could answer difficult questions;

> *"It does influence your perception of the person, how they come across, if they're back tracking or they're tripped up by the lawyer and try to answer it, instead of just saying I'm not sure about this or if it sounds like a contrived answer then that kind of sways my thinking about what the person (expert) is saying."*

4.3.3 How the Expert Witness Explained the Evidence

Many of the jurors explained that credibility was tied to how the expert witness explained the evidence they were called to testify about. Expert witnesses know it is important to make sure the scientific evidence is accessible and understandable to the lay juror. This brings to light the fact that the ability of the expert to explain the scientific evidence is tied to credibility in the juror's mind. "Martin" explained credibility this way:

> *"as they have a conversation about their area of expertise, how did they explain it? Were they explaining in a way that they had a command of the information and yet they could explain it to lay people and the jury in a simple way?"*

"Gregory" explained credibility in almost the same manner:

> *"I think their ability to explain ... On the scientific side of it, their ability to explain what they're talking about in layman's terms."*

The jurors expect the expert witness to present in a clear manner and also expect the testimony to be engaging. "Harold" stated that credibility was based on:

"how they come across, their personality. Some people can be experts and be very rigid and stuffy and whatever and other people have come across quite naturally and I think that's a part of (credibility)".

"Harold" commented on a tool mark examiner who testified to her comparison between a wrench and a skull fracture:

"I was totally impressed with that woman, but she did say…she couldn't say beyond a shadow of a doubt that that was what happened. She just blew me away and then I just believed the woman."

"Matthew" described how a bloodstain pattern expert explained the science behind the repeatability of bloodstain patterns and how this explanation lent to the credibility of the expert:

"But those that specialize in blood spatter, so they can tell which way a blade was being thrown, forward or backward or what, and I guess just, in general, science has proven that to be true, the way that they present it to you."

4.3.4 Experts being put forth by the Government

Of some concern to the justice system may be the responses from jurors who based the expert witness credibility on the fact that they were state employees or being presented by a prosecution attorney. These jurors appeared to believe that credibility automatically applied to any expert accepted by the judge. "Grace" believed the expert witnesses were formally licensed as forensic scientists and as expert witnesses. At this time forensic scientists in the State of Maine are not licensed and the decision to allow an individual to testify as an expert rests with the judge alone.

“They (expert witnesses) were licensed by the State of Maine to do the work that they did.”

It is to be expected that jurors who are unfamiliar with the role of forensics scientists and the responsibility of the judge as the gatekeeper might place undue weight on the credibility of an expert just because they work for the government. “Justin” explained it as:

“There is a whole level of inherent trust that you tend to apply to someone who comes forward that is brought to the case from the government.”

“Matthew” expressed how he determined credibility:

“I think that if you are employed by the government of Maine, I'd like to think that they're only going to hire people that know what they're talking about.”

For many professions in Maine and across the United States licenses and certifications are necessary to perform business. Examples include hairdressers, barbers, tax accountants, nurses and doctors. This is not the case currently for forensics scientists. “Larry”, and possibly others, inferred that since licenses required in other industries, forensic scientists were also licensed.

“I would have to first feel comfortable that the party introducing them to me is credible and then that I have trust in whoever is coming. I work in a field, here in my job where an engineer puts their stamp on something, they're speaking on behalf of an industry standard or whatever. They're actually liable personally for what they're saying. I would hope that if we had an expert witness talking about whatever, I heard all kinds of them. I guess, myself knowing industry standards, I would make the, and I hate to use the word assumption but I will, assumption that they're speaking on behalf of their field of expertise and I would like to believe that

they are offering credible information rather than tainted information. The experts were acting as representatives of the state of Maine rather than some private hire for the gun industry, or something. My opinion was that they had to be credible to serve doing the functions they were for the state."

4.4 Jurors' Interpretation of Credibility across Specific Disciplines

Jurors were asked on the paper survey to rate the credibility of each of the expert witnesses they saw at the trial. Jurors chose from a Likert scale (Appendix 4, Question 13). Figures 12-18 illustrate the results relating to the various evidence types.

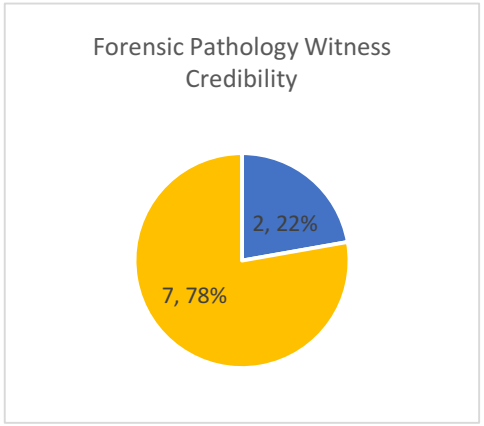

Figure 12: Jurors' Interpretation of pathology Witness Credibility

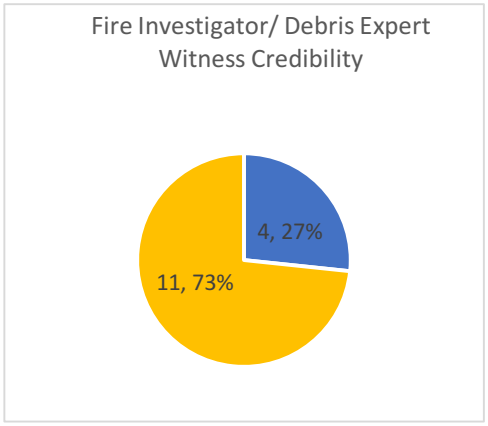

Figure 13: Juror' Interpretation of Fire Investigator/debris expert credibility

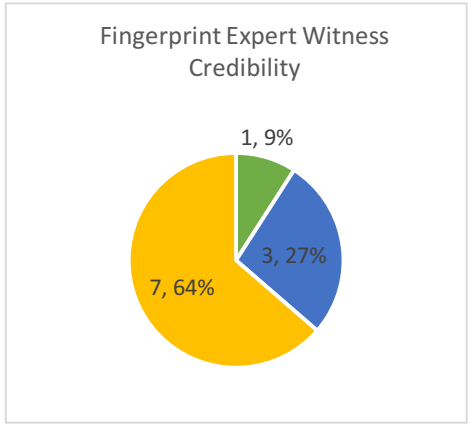

Figure 14: Juror' Interpretation of Fingerprint Examiner credibility

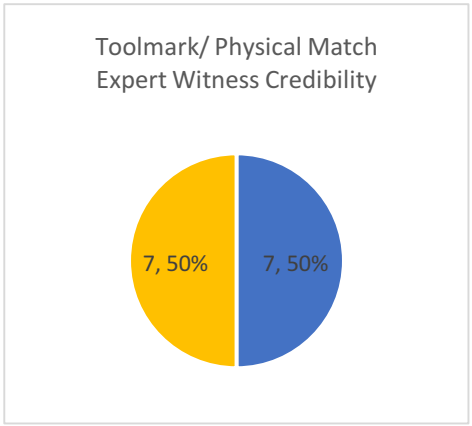

Figure 15: Jurors' Interpretation of toolmark/ physical match credibility

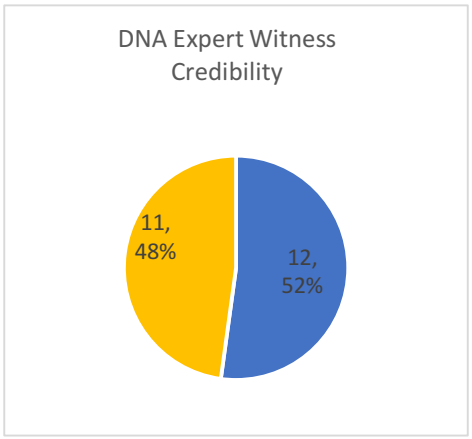

Figure 16: Jurors' Interpretation of DNA Examiner credibility

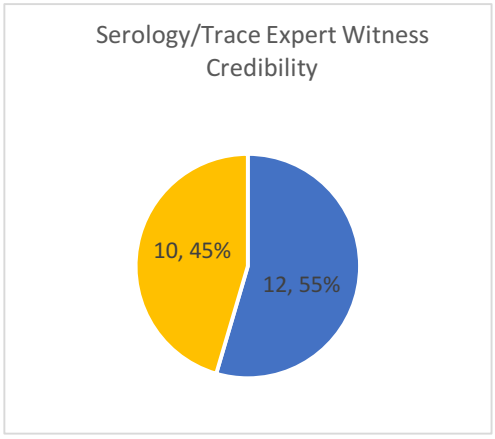

Figure 17: Jurors' Interpretation of Serology/ Trace Examiner credibility

Figure 18: Jurors' Interpretation of Footwear/ Tiremark Examiner credibility

In interview jurors stated that they appreciated when the expert witnesses used visual aids (forensic pathologists, fingerprint examiners, physical match examiners and tool mark examiners). The forensic pathologists used traditional poster presentations. These posters explained where particular wounds were documented on the victim's body. The tool mark, fingerprint and physical matching experts used PowerPoint type displays to help explain their conclusions.

During these presentations it was clear that some expert witnesses developed more of a rapport with the jury than other witnesses. When the expert witness played more of an educator's role and took the time to teach the jurors a little about the science and how they came to their conclusions the jurors appears to be more engaged. Jurors nodded their heads, made a lot of eye contact with the expert and looked at their fingers during the testimony of the fingerprint experts.

Jurors mentioned that they did not understand DNA evidence and that this lack of understanding may have influenced their overall rating of the witness's credibility. The footwear and tire mark evidence experts testified to class characteristics associations and not individualizations or 'matches'. They testified that the crime scene impression(s) and known shoes/tires had the same pattern but could not be more specific in their conclusions. The footwear and tire evidence across all 9 homicide cases was the least definitive and this may have influenced the overall juror perspectives of the credibility of these expert witnesses.

"Charlotte" stated:

"The tire tracks, I think that it is more difficult, it's not always clear cut, if it actually was the specific tire".

Figure 19 illustrates the spread of jurors' rating of expert witness credibility across the disciplines. Apart from the fingerprint examiners all of the other expert witnesses were rated very credible or credible by the jurors.

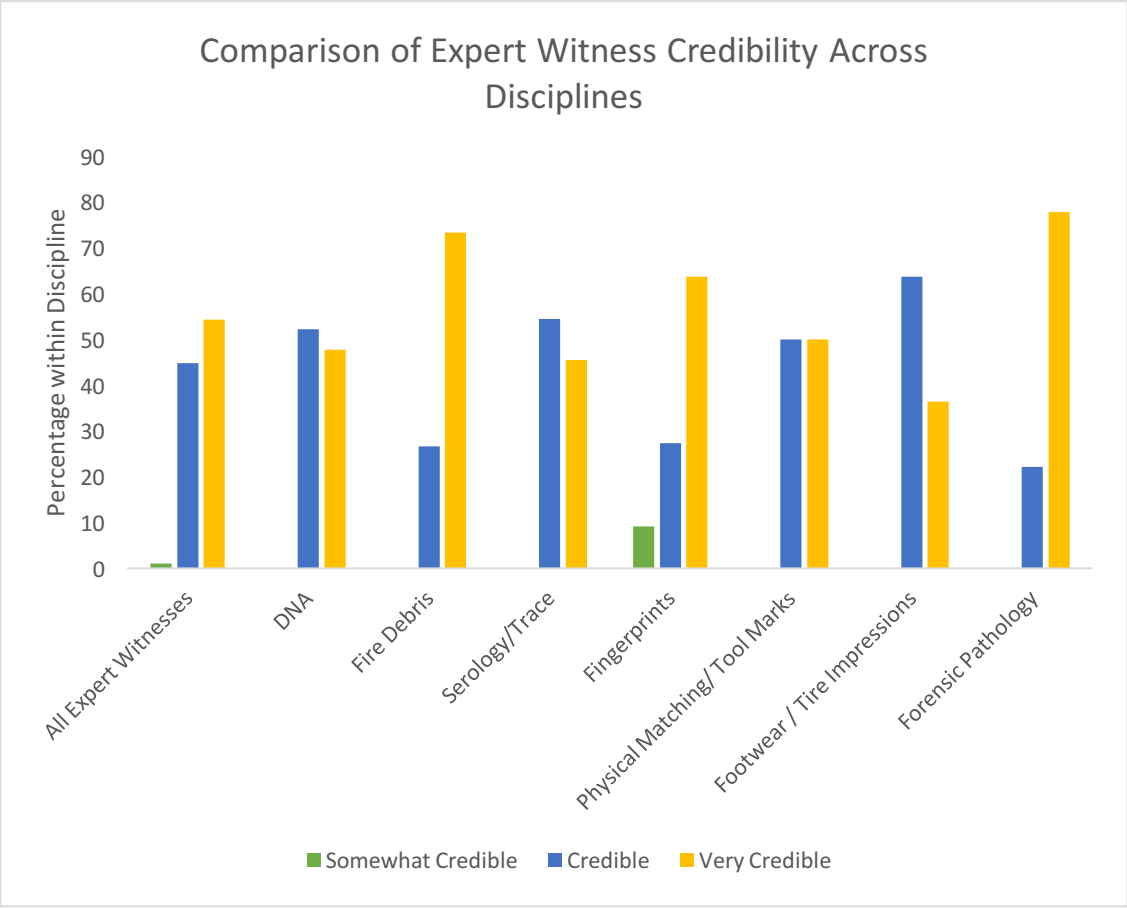

Figure 19: Jurors' Interpretation of Expert Witness Credibility

4.5 Jurors Evaluate Forensic Evidence

Jurors were asked to rate the reliability of each of the forensic science disciplines they were introduced to during the trial. A follow up question during the phone interview asked jurors to explain how they judged whether in their view evidence was reliable or not (Figures 20 and 21). By combining all juror responses over all forensic disciplines we see that 45% of the time jurors rated forensic science as very reliable.

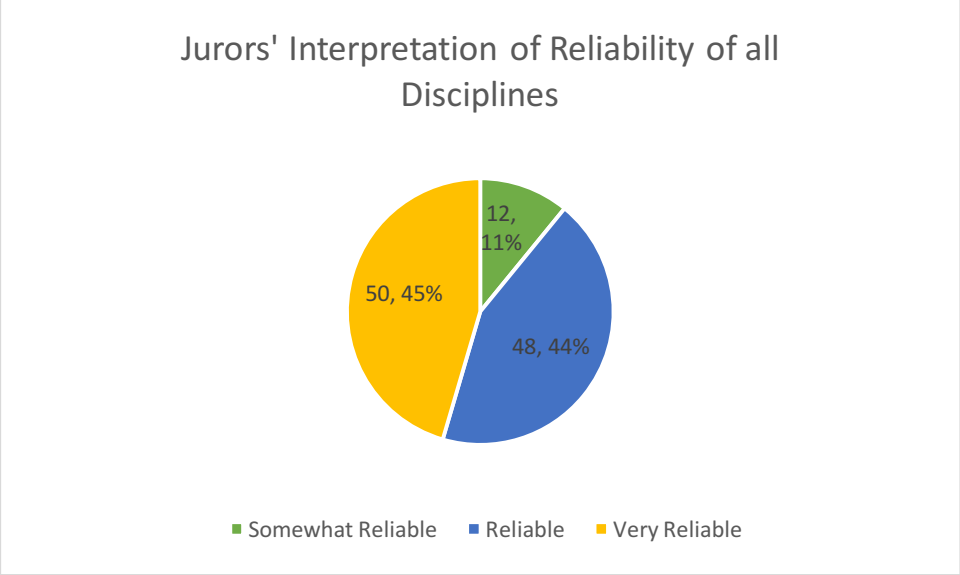

Figure 20: Jurors' Interpretation of Reliability of Forensic Science

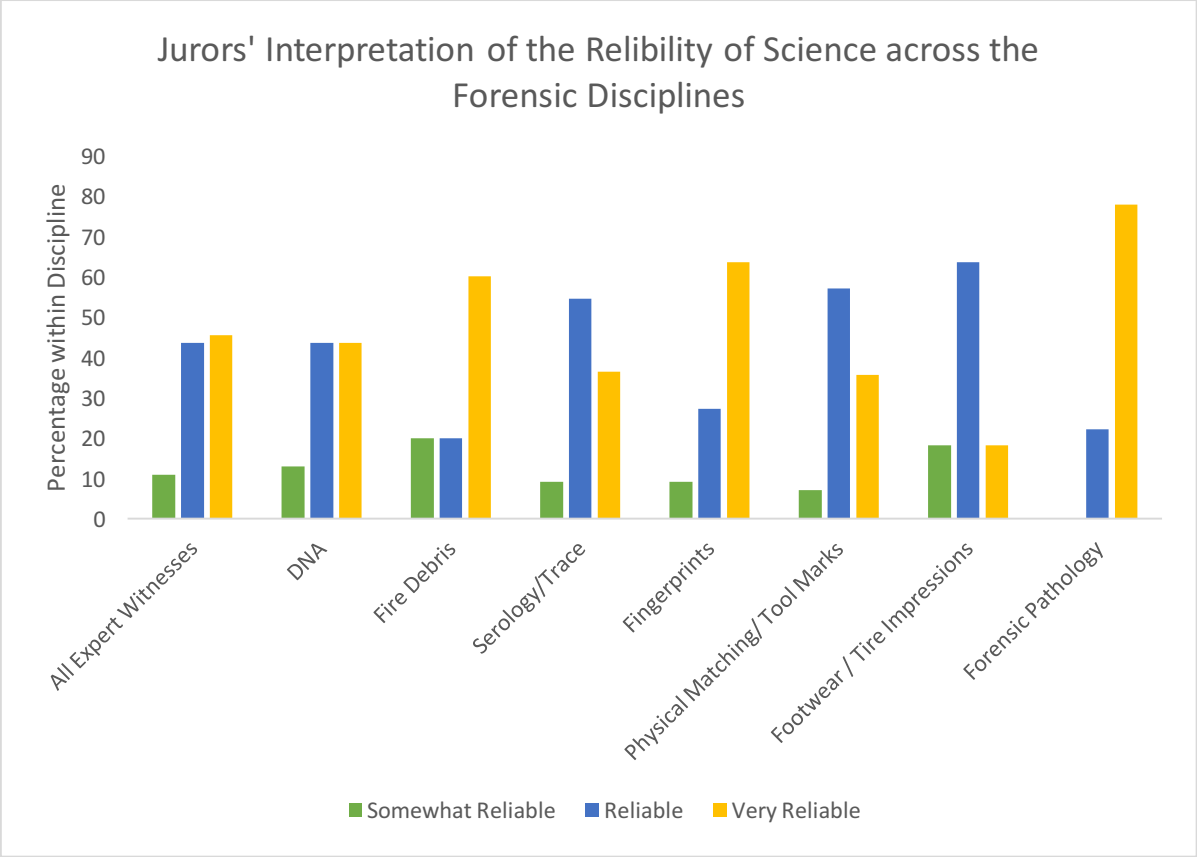

Figure 21: Jurors' Interpretation of Reliability of a Range of Forensic Science Disciplines

4.5.1 Chain of Custody

Chain of custody for an item of evidence is a written or electronic record of the location of an item of evidence from the time between is collected at a crime scene and when it is presented in court. Chain of custody is important as it lays a legal foundation for the evidence, and should demonstrate that the evidence has not been changed in any way (other than those documented) (Evans and Stagner, 2003).

The most common explanation for how jurors determined the reliability of an item

of evidence was the method and means of collection. Chain of custody was important to many of the jurors in evaluating the reliability of the evidence. Jurors described that how the evidence was found, by who and whether proper protocols were followed were important in determining reliability. When describing how she determined how reliable the fire debris evidence was "Amy" stated:

> *"I think it was super important for them to describe the normal process of collection, what normally would happen, and then to reinforce that it was collected in that fashion, that they followed protocol"*.

Another juror, "Gillian" described reliability of evidence based on the:

> *"way that it is handled and the way that it was presented to us. The way they secured the scene and bagged everything separately and used rubber gloves and that kind of thing, I think that makes evidence credible, when it's tested then it's hard to have contamination there, when it's collected the way they did in this particular trial."*

A few jurors went further and stated that evidence reliability was based on how likely it was to have been tampered with. These jurors needed to hear about the chain of custody procedures and steps to prevent contamination to help them determine reliability of the evidence. "Gregory" stated:

> *"I think things that can't be altered by people (such as) the cell phone data. That's automatically logged and can't be manipulated by people, or like DNA evidence or*

fingerprints. There's nothing subjective to that at all."

"Alana" described reliable evidence as evidence with low:

"opportunity to be messed with"

and "Charlotte" said reliable evidence is evidence that:

"is harder to manipulate".

It is clear that the jury are placing an importance on information relating to the chain of custody and that this is one of the factors that influence their perception of evidence reliability.

4.5.2 Corroborated Evidence

Some jurors described how when evidence was corroborated by other lay witnesses or other experts, that this increased their perception of the reliability of the evidence. This is an example of the story model of information processing described in Chapter 3. "Ann" described how she rated the reliability of DNA evidence as evidence that:

"lines up exactly in terms of the evidence but also the incident. That there's a direct correlation there."

"Charlotte" stated reliable evidence is:

"tested by different people and looked at and scrutinized by people who were trained to look at evidence. I guess again, knowing that a lot of people looked at it, I put a lot of faith in the quality of the evidence."

4.5.3 Significance to the Case

Jurors also described reliability relating to specific physical items of evidence that they decided had a strong significance to the case. In a homicide case where the victims were burned, a kerosene container was found melted near the victims. "Alana" stated:

"in this case it was the gas can. The melted gas can that did it for me."

Other jurors described evidence as being reliable in terms of how unique or specific the evidence was. "Ann" stated evidence reliability rested on its uniqueness:

"I think I would go with things like DNA, or things that are an exact match".

When describing evidence reliability jurors mentioned DNA and fingerprints as being examples of reliable evidence. "Gary" commented on the reliability of a letter reported to have been written by the defendant:

"the handwriting people said it was his handwriting and the fingerprints on it, made it solid to me".

Other jurors mentioned arson detecting dogs, tire impressions and cell phone tower evidence being highly reliable from their perspective.

4.5.4 Knowledge about the Evidence

A few jurors based their determination of reliability on how well they understood the evidence. In response to the question of how she decided whether evidence was reliable or not, “Allison” described being able to hold a gun that had been entered into evidence and examine the location of the gun safety switch as important. She said:

> *“Holding the gun and being able to examine the safety on it really helped me to understand and determine the reliability of the evidence”*.

“Dana” said she relied on her training and experience in the medical field to evaluate expert testimony she heard during the trial:

> *“given my background in the medical field, the medical examiner’s evidence on sperm cells remaining after decomposition, freezing and thawing was just an estimate and was less reliable than DNA on chewing gum”.*

4.5.5 The Science behind the Evidence

Two jurors mentioned that evidence reliability was based on the science that the evidence is based upon. “Gary” put it in his own words when he said:

"I mean there's the science, certainly, behind it."

"Justin" explained evidence reliability:

"*It's pure science, it's not people's observations and matching, when someone is reporting on a fingerprint and they're interpreting that, it's got some scientific background to it. That helps me … trust it."*

4.5.5.1 DNA Evidence

Jurors were asked to rate the reliability of DNA evidence if DNA evidence was presented during the trial. Figure 22 illustrates the responses from the jurors. Jurors explained on the survey whether they determined DNA evidence to be reliable.

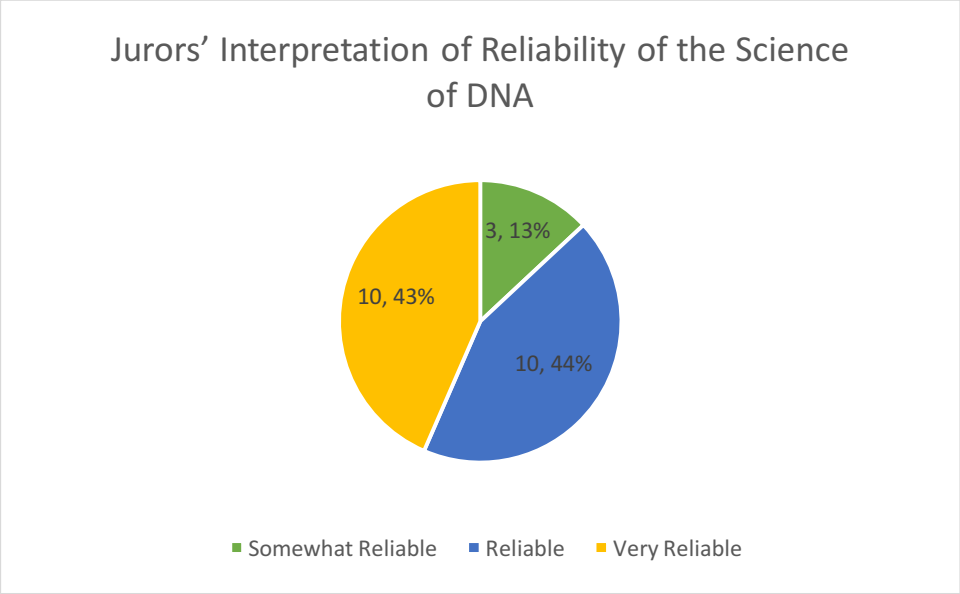

Figure 22: How Jurors Rated the Reliability of DNA Evidence

An opened ended question in the survey asked jurors to explain why they thought

DNA evidence was reliable/unreliable. The most common reason jurors gave for believing DNA evidence was reliable was how specific the evidence could be. “Ann” stated:

“DNA does not lie. Either it is yours or not, unless you have a twin”

and “Grace” stated DNA evidence was reliable because there is:

“only one match for each human”.

“Gail” understood DNA to be reliable because:

“It is a person’s genetic signature”.

Another common reason jurors gave for explaining the reliability of DNA evidence was due to their perceptions that DNA was based on a reliable science. “Gregory” explained that reliability was based on the science:

“It is a mature science, (and the) equipment is standard”.

“Grace” explained how she determined DNA evidence reliability:

“sometimes a clean match cannot be made- in those instances it’s just a likelihood of a match. In other instances a very clear match was made and in these instances the science is reliable”.

A few jurors connected the reliability of DNA evidence based on their perceptions of accuracy of the conclusions. ”Christopher” described how he rated the reliability of DNA

evidence:

"*DNA has been proven to be almost 100% accurate.*"

"Larry" described the accuracy of the DNA:

"It appeared to be indisputable and accurate"

and "Lloyd" stated DNA is reliable because:

"*DNA testing has been the form of science that is always 90+% accurate".*

Finally, two jurors stated they based their judgment of the reliability of DNA evidence on personal knowledge. "Harold" said:

"Largely the press had educated us that this testing, if proper samples can be uncovered, is extremely reliable"

and "Luke" stated:

"I believe it is reliable because of what I have read not because I understand it (given the testimony)".

"Charlotte" said:

"I would trust DNA the most out of anything. It's harder to forge"

4.5.5.2 Fire Investigation and Fire Debris Evidence

Figure 23 illustrates the responses from the jurors from the surveys. Sixty percentage felt fire scene evidence was very reliable, 20% rated fire scene evidence as

reliable and 20% rated fire scene evidence as somewhat reliable.

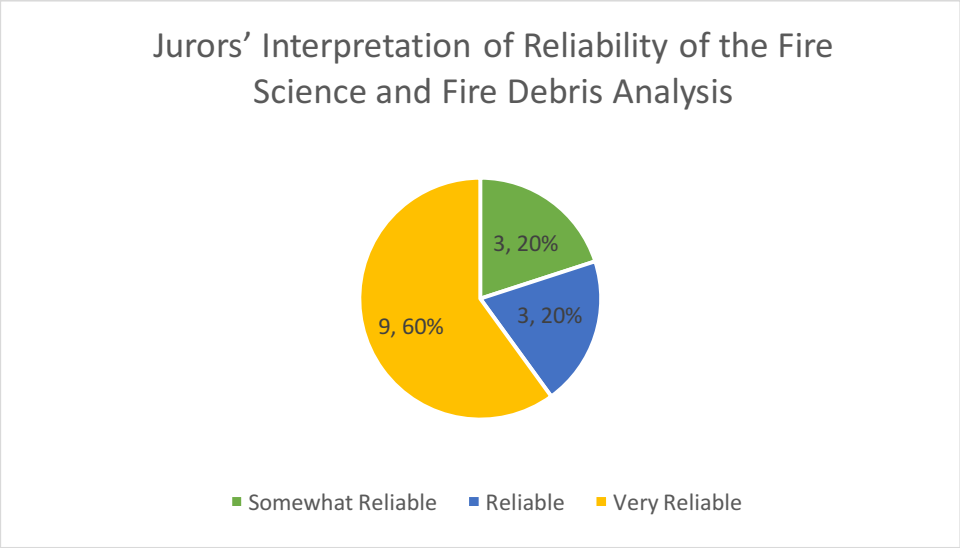

Figure 23: How Jurors Rated the Reliability of Fire Investigation and Fire Debris Evidence

Jurors gave a range of explanations related to their responses which could be categorized as the science behind the evidence and how the experts presented the evidence. "Harold" explained:

"I believe this type of testing is based on sound scientific principles"

and "Heidi" described reliability in terms of repeatability of the science:

"(the) chemical response is fairly constant, that's what makes it a science, it is an established truth".

Other jurors based the reliability on how the expert presented the evidence. Commenting on one expert, "Alana" said the expert:

"was confident in his answers and data and when he was not he told us he was not able to determine those particular facts."

"Amy" described how the expert witness's testimony indicated the reliability of the science:

> *"The explanation of the techniques, rationale for decision-making and the behavior of fires vs. those with an accelerants. Poise of expert, ability to answer questions with confidence."*

4.5.5.3 Serology and Trace Evidence

The serology and trace examiners testified to presence or absence of biological stains such as blood and semen, to fabric damage on items of clothing and bedding and to fibers and hairs collected. Jurors' responses can be broken up into two major categories; how closely the serology and trace evidence followed the other aspects of the case and secondly the science behind the evidence presented. Figure 24 illustrates the jurors' responses.

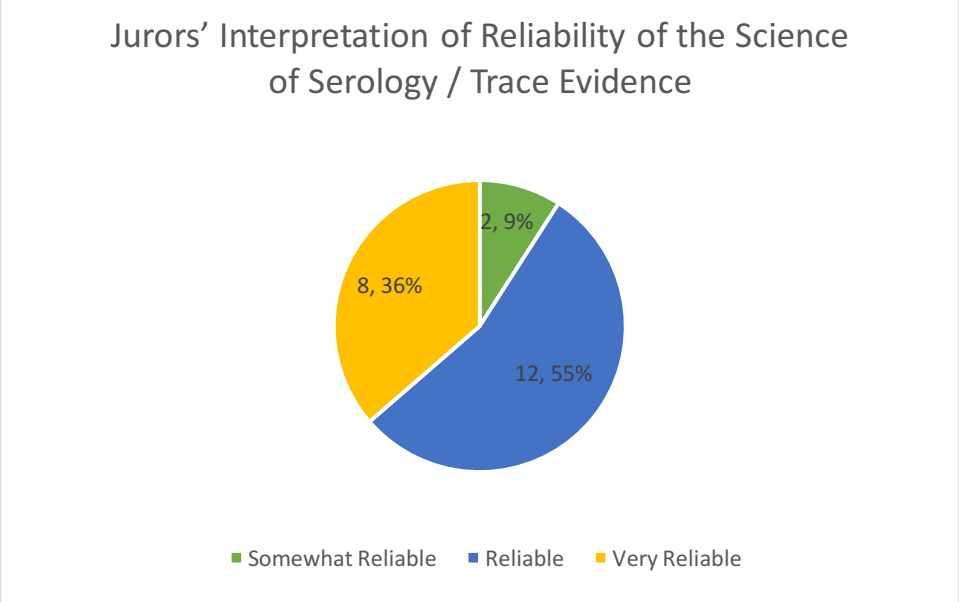

Figure 24: How Jurors Rated the Reliability of Serology and Trace Evidence

"Clare" stated:

"it can help to complete an accurate picture of all evidence presented, to conclude a reliable picture."

In "Larry's" words trace evidence is:

"very much reliable, her explanation directly followed evidence"

and "Luke" stated;

"it corroborated with other evidence, that the person was involved with the event. I believe it plays a supportive role."

"Dana" described a serology expert:

"her testimony remained objective and fact-driven. She seemed confident in the process with which her lab handled specimens, and experienced in the field."

"Matthew" stated that serology and trace evidence are:

"Scientific facts and do not lie, nor are they unreliable".

"Mark" stated that serology/trace evidence is reliable because:

"it has been tested in either field work or laboratory experiments, or both".

4.5.5.4 Fingerprint Evidence

Sixty four percent or jurors felt fingerprints evidence was very reliable, 27% rated

it as reliable and 9% rated fingerprint evidence as somewhat reliable (Figure 25).

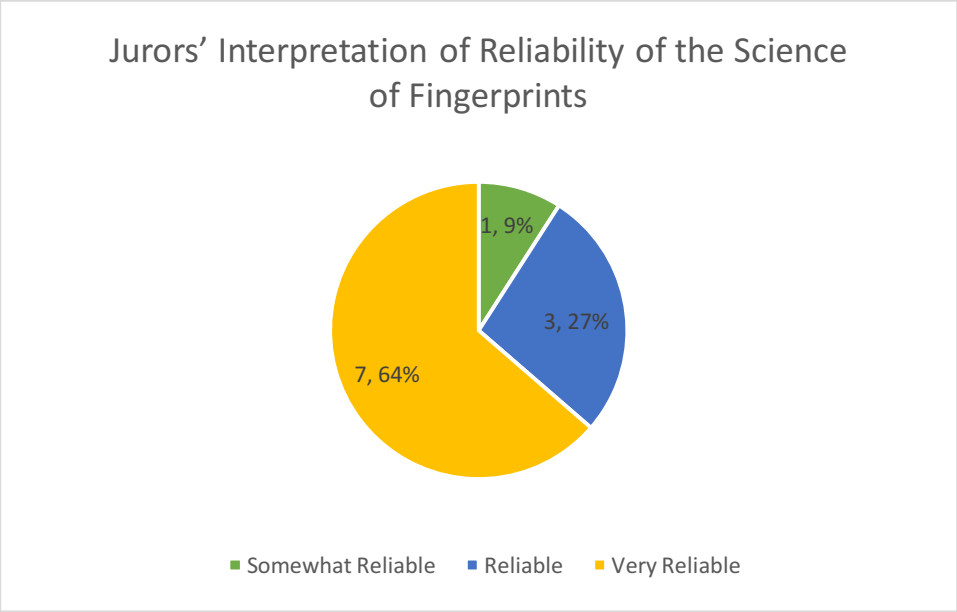

Figure 25: How Jurors Rated the Reliability of Fingerprint Evidence

An opened ended question on the survey asked jurors to explain why they thought fingerprint evidence was reliable. Jurors gave a range of responses of which the predominant reason was that fingerprints are reliable because jurors perceived them to be unique. "Gary" explained why fingerprints are reliable by stating:

> *"fingerprints are unique they can prove where someone was or what they had in their possession".*

"Martin" wrote:

> "*(fingerprints are) reliable- this is another unique identifier for who was involved"*

and "Matthew" commented:

"It is an old but proven way to determine who was touching an item. Just like DNA, everyone has a unique fingerprint".

Jurors commented on the reliability based on the level of subjectivity of the fingerprint examiners they perceived. "Grace" and "Gregory" commented on the same fingerprint expert witness who testified to a fingerprint identification connecting the defendant to the crime. Grace explained that she felt fingerprint evidence was subjective and less reliable than DNA. Gregory described the fingerprint evidence as not being subjective and that he placed a lot of weight on it.

Researcher: *"Grace", what, in your opinion, makes evidence reliable? What type of forensic evidence would be more reliable than others in your opinion?*

"Grace": *DNA is convincing. I learned a lot about DNA during the trial because they described a lot about DNA evidence to us.*

Researcher: *What type of forensic evidence might be less reliable?*

"Grace": *I have to think of an example. When there weren't any fingerprints, when something was in the right place and it's in the right location but there weren't any bodily fluids or fingerprint or something connected to the person to match with. I don't know if there's a word for that kind of evidence.*

Researcher: *The absence of evidence for you then, you then question the reliability?*

“Grace”: *Yeah, like the absence of fingerprints, bodily fluids, things that you could actually connect to a person.*

Researcher: *If I was to say DNA and fingerprints, bullet comparisons, detection of gasoline in an arson case, do you think any of those are all equally reliable or would you think some of the forensic sciences are more reliable than others*?

“Grace”: *I think some of the forensic sciences are more reliable than others. Of course, I'm just a lay person in terms of forensic science but I think that fingerprints are less reliable than DNA evidence.*

Researcher: *Would you be able to tell me why you think that?*

“Grace”: *I don't know but I could try.*

Researcher: *Okay.*

“Grace”: *I think sometimes you just get a little piece of a fingerprint and it's more of a subjective science where you have a fingerprint analyst reviewing it and looking for a pattern. I don't think it's completely subjective by any means. I know it's a science and that they have a protocol that they follow. They look for really specific patterns but, to me, it seems a little bit less quantitatively scientific than DNA evidence which can give you a percentage of this matches ... This DNA sample matches this other DNA sample to a 95% reliability. Then, you can figure out to what extent ... I don't know.*
I guess, I like that quantitative piece of the DNA evidence where

there is maybe a 2% likelihood that it wouldn't be that same person, and this is how. I think DNA forensics have more reliability in general than fingerprints.

"Gregory" explained why he thought the science of fingerprints was reliable:

"Gregory": *Again, you know where it's been, and if everything was documented and who handled it. All of that documented, and if it's scientific, is it factual or is it an opinion? Most scientific things are not opinion-based at all. They're factual.*

Researcher: *Mm-hmm (affirmative).*

"Gregory": *Like in the fingerprints. The defense attorney tried to discredit the (expert) because she only had 36 points, and he didn't (understand) the points because she wasn't saying you have to have 36. It (the chart) was just showing that you could have put hundreds up there. It doesn't matter, if the fingerprint matches.*

Researcher: *Yes, I saw that*.

"Gregory": *Yeah, and that was a factual thing. If you showed those fingerprints ... Any fingerprint, really, in the world, they (other experts) all would say, "Yes, this is a match."*

"Harold" explained an instance where an investigator's fingerprint was located on an item of evidence and this reduced his sense of reliability on the fingerprint evidence:

"I believe a print of one of the investigators was found on a weapon? This hurt the credibility of this evidence".

"Justin" described a how the science of fingerprints can be subjective and how this

influenced his perceptions of the reliability. He described a Frontline TV show (Cediel and Bergman, 2012) that presented the misidentification of Brandon Mayfield by the FBI using fingerprint evidence (Stacey, 2004) and how unconscious bias played a part in the mistake.

Researcher: *What types of forensic evidence do you think might be more reliable than others? …What about fingerprints?*

"Justin": *From what I've read and saw on the show (Frontline) that's another sketchy science. They gave an example where …the European police sent a photograph… (of a fingerprint) to the FBI in the U.S. and they identified it as a person in (Oregon) and it matched from what this expert said. There is a certain number of points that the person has to judge to make it a match. The guy (accused) ended up fighting it and it turned out this guy in Europe admitted to the murder (participation in the 2004 Madrid train bombing). A US expert … said it was a perfect match and it was two different people.*
I thought like (on) CSI, you had a computer that went through and matched 100%, but that's not what happened. I just have doubt in fingerprints, but it's another piece of evidence that can help add up to a direction. I wouldn't really rely on it 100% as the only piece of evidence.

4.5.5.5 Toolmarks and Physical Matching

Jurors were asked to rate the reliability of the toolmarks and physical matching evidence presented during the trial. Figure 26 illustrates the responses from the jurors.

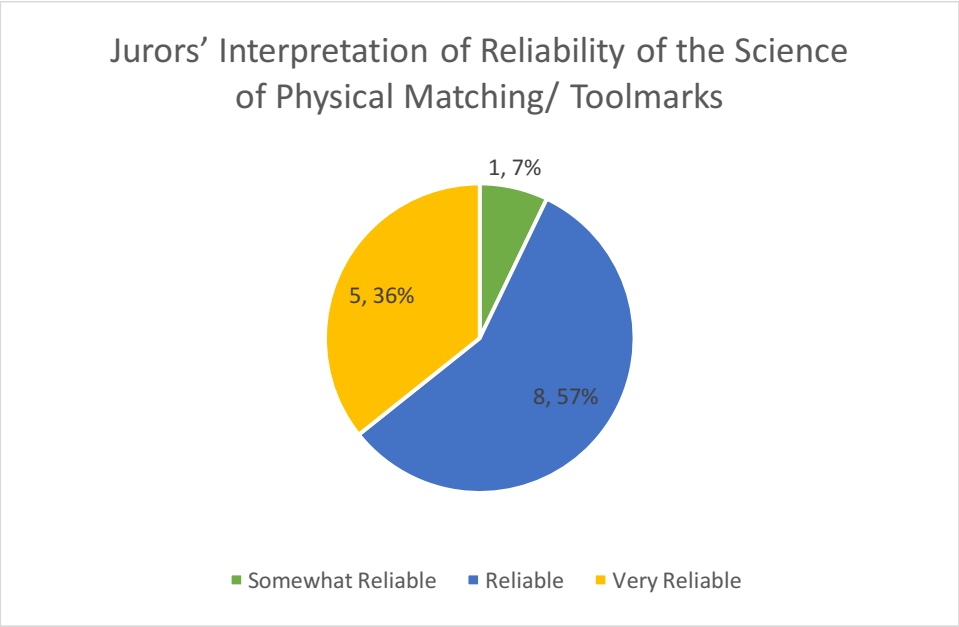

Figure 26: How Jurors Rated the Reliability of Toolmark/ Physical Matching Evidence

Jurors described the reliability of toolmark and physical matching evidence based on a general sense of trust. "Charles" wrote about a physical match of a garbage bag:

"I trust this matching process"

and "Harold" explained toolmark evidence was reliable:

"*because (Expert Witness) did a superb job of explaining the methodology".*

The testimonial evidence given by the toolmark and physical matching expert witnesses were supplemented with demonstrative aids, such a photographs and slide shows. The jurors' sense of trust in the reliability may be based on the visual aids they observed during the trial. "Heidi" commented:

"Seriously? I think it's highly unlikely that tool marks could resemble anything

other than the tool that made them."

"Christopher" based the reliability of physical matching evidence on what he was able to see from the visual aid presented at the trial:

"A good example was the trash bag under a microscope you could see where they were separated".

4.5.5.6 Footwear and Tire Evidence

Jurors were asked to rate the reliability of the footwear and tire evidence presented during the trial. Figure 27 depicts the responses from the jurors.

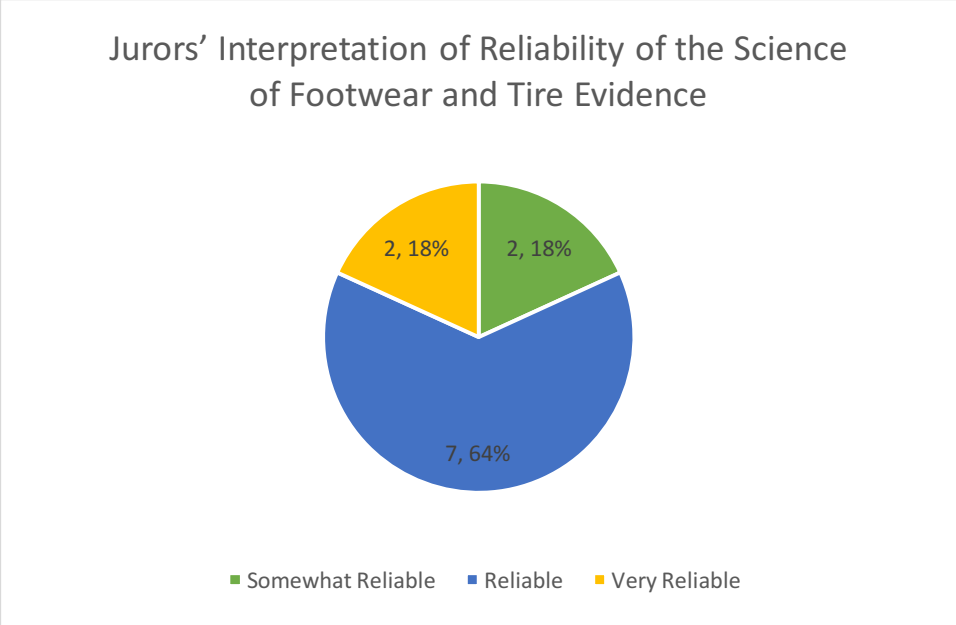

Figure 27: How Jurors Rated the Reliability of Footwear and Tire Evidence

Jurors described reliability in relation to how footwear and tires become unique due to wear that is caused by normal use. "Laura" explained why wear made footwear

comparison reliable:

"how shoes are worn out are different for each individual, at least very unlikely that 2 people wear shoes out the same way"

and "Christopher" wrote that tire impressions are reliable because:

"all tires can wear differently and wheelbases on vehicles can be calculated but not changed".

Jurors rated footwear and tire impression evidence the least reliable of the evidence types observed and this may be due to the way in which this evidence was presented at court where the experts suggested inclusion rather than certainty, rather than any perceived underpinning science behind the discipline. The footwear and tire evidence presented at the trials included in this study were class characteristics comparisons. The expert witnesses, in their evidence, did not make definitive "matches" or individualizations. The expert witnesses testified that the crime scene impressions could have been made by the known shoes/tires and that other shoes/tires could also have made the crime scene impression. These conclusions were in contrast to the conclusions given by DNA, fingerprint and physical matching experts.

"Charlotte" described how the class characteristics association presented at the trial influenced her perception of reliability of tire evidence:

"I think it can narrow down the type of tire/vehicle but not the specific vehicle".

"Amy" explained why footwear evidence may not be as reliable as DNA when she described the limitations of the evidence found at a crime scene:

"footprint analysis is probably somewhat more difficult (to match)".

Charlotte also described how the evidence itself at the scene can limit the possible conclusions an examiner might make and thus in her opinion make the science of tire comparisons less reliable:

"the tire tracks, I think are more difficult, it's just not always clear cut, if it actually was this specific tire".

4.5.12 Forensic Pathology

Jurors were asked to rate the reliability of the forensic pathology evidence presented during the trial. Figure 28 illustrates the responses from the jurors.

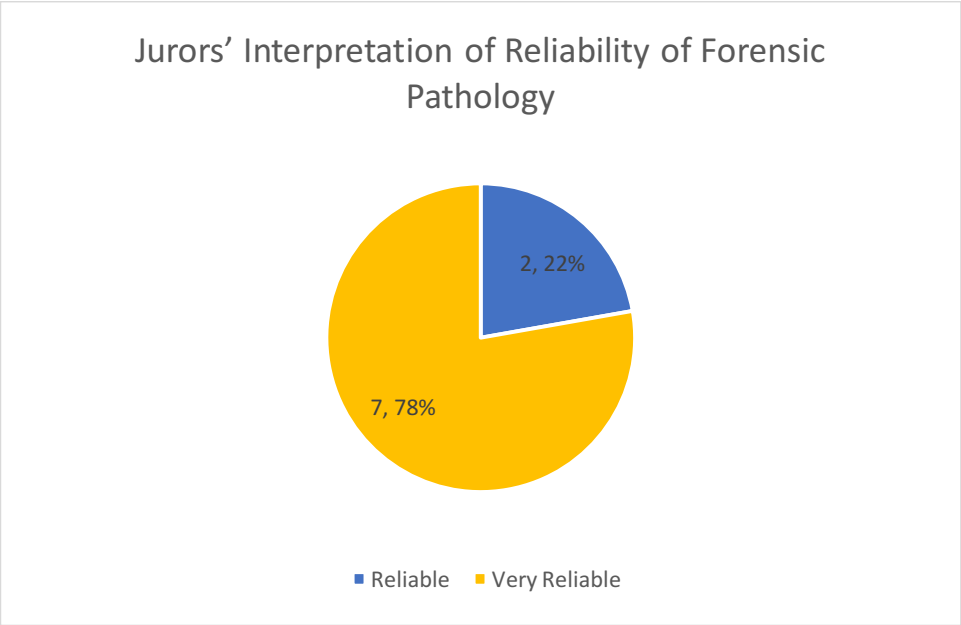

Figure 28: How jurors rated the reliability of forensic pathology evidence

Jurors commented that forensic pathology was reliable because it was based on a solid science background. "Gregory" based the reliability on it being a *"mature science, almost a standard in today's world"* and "Matthew" wrote:

> *"This is a proven scientific method. I am fully convinced of its accuracy".*

A few of the jurors connected the reliability of the forensic pathology testimony with the expert speaking on behalf of the victim specifically where as other experts testified about physical evidence, the forensic pathologists testified about the decedent. "Gary" said:

> *"it's reliable as it shows or at least gives a sense of what various injuries mean and how they may have occurred. It also invokes a great deal of empathy for the victim, more so than the other expert testimonies".*

The use of visual aids helped jurors understand and supplement the testimony of the expert witnesses. “Lloyd” described how the visual aids helped him understand the injuries on the decedent and measure reliability of the testimony:

> *“I was comfortable with everything I heard. Especially with the forensic pathologist. He gave us a little presentation, and to me that was interesting, but it was also very informative. I learned a lot from that. I relied on it. For instance, when he said that the jaw had been stomped on, the way that his jaw was offline or something like that, that it looked like he would have stomped his head, and he explained how you could tell that. That was very good. I understood that, and I could believe that happened.”*

Larry said that:

> *“Reliable evidence is something that I should be able to see. I should be able to see it and maybe touch it physically or have it in sight and pass through my hands or read it on a credible document.”*

This highlights the importance of visual aids in relation to perceived reliability of the evidence.

4.5.5.13 Overall View of Reliability of the Forensic Disciplines

Jurors viewed the range of forensic science disciplines through different lenses to determine reliability of the evidence. Figure 29 depicts the range of juror responses when evaluating the reliability of different forensic evidence. None of the forensic disciplines

were rated as “not credible”.

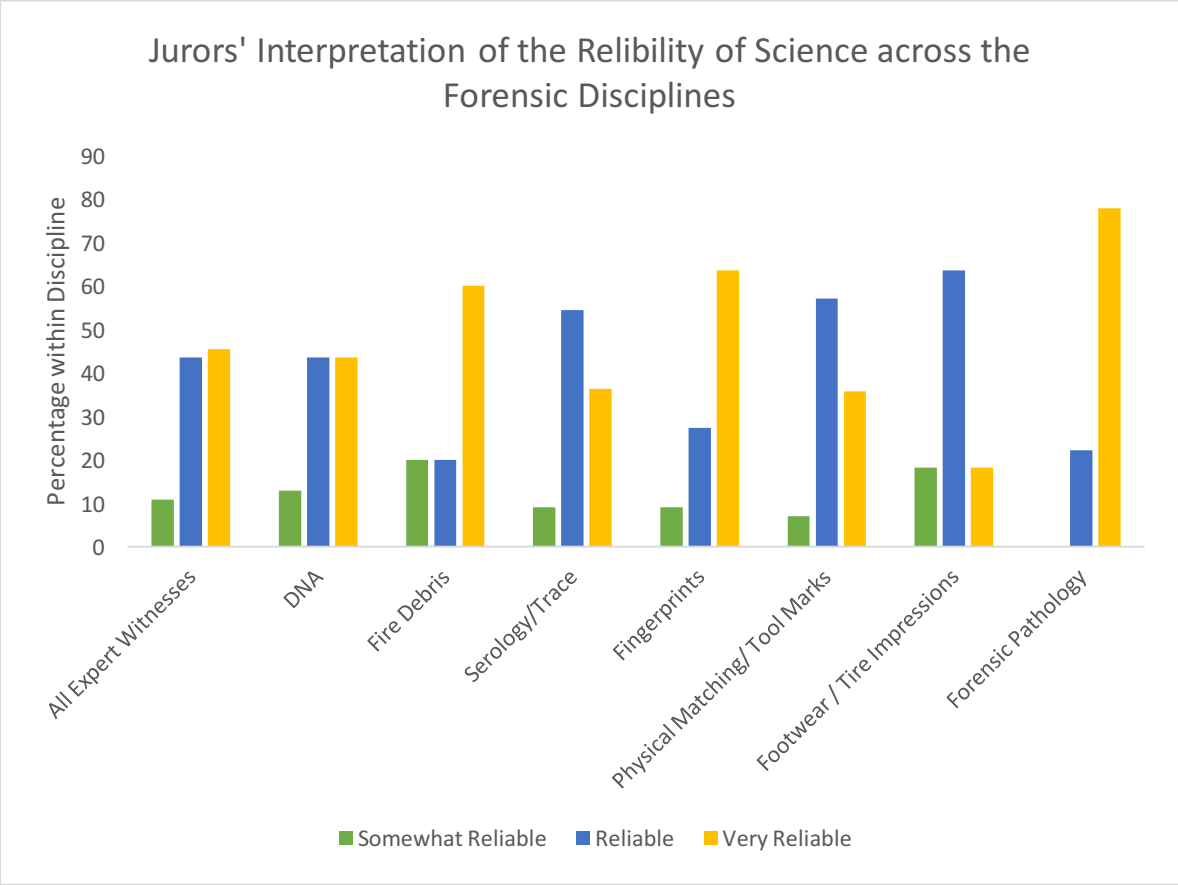

Figure 29: How jurors rated different forensic science disciplines

4.6 The Witness Represents the Science

When asked during the phone interview, whether the scientific witnesses or other witnesses such as the police or lay witnesses had the most impact on decision-making, 68% of the jurors said the scientific witnesses were most important and had a large influence on the verdicts rendered.

For the most part, jurors were unfamiliar with the methodology used in the examination of the various evidence types or whether there is any credible robust science underpinning this evidence and as such are blind to the scientific reliability of the different forensic science evidence types presented to them. Many of the jurors described the case they heard as their first in-depth introduction to the methods and procedures within the forensic science disciplines presented at the trial.

It was observed that jurors appear to base the reliability of the forensic evidence on their perception of the expert witness's credibility with a moderate positive correlation (Pearson's correlation coefficient of +0.44, N=29, P= .01) between jurors' perceptions of the reliability of evidence reliability and the credibility of the witness.

4.7 Testimony Style and the Strength of the Evidence

In section 3.2 the theory that jury verdicts are driven by the strength of the evidence presented to them at court was introduced. This theory suggests that strong exculpatory evidence (evidence that tends to suggest that the defendant did not commit the crime) or strong inculpatory evidence (evidence that tends to implicate the defendant) will play a major role in jury decision making. In this way, verdicts will be driven by the quality and the quantity of the evidence presented, including forensic science evidence. The question remains, what constitutes strong forensic science evidence in the mind of the jury?

One of the many challenges that face forensic scientists when they testify to laypersons on a jury is to accurately communicate the strengths and limitations of the evidence they are testifying about. Expert witnesses tend to testify in one of two ways; by using narrative language to describe the weight of the evidence or by giving a probabilistic weight to the evidence. When a forensic scientist testifies using narrative language they explain to the jurors the value of the evidence and the reasons behind its value. Expert witnesses who testify using narrative language often use demonstrative aids such as pictures, diagrams, photographs or charts to illustrate their conclusions. On the other hand, other forensic scientists explain the value/ strength of the evidence through the use of probabilities and numerical values.

The testimony style of the forensic scientist is usually dictated by the forensic science discipline itself. For example, feature comparative forensic science disciplines such as fingerprint, bullet or footwear mark comparisons are usually presented in narrative form, where the expert witness explains to the jury how they came to their conclusion. For other forensic science disciplines, where instrumental analysis makes up the basis for the examiner's conclusions, the testimony will often include a probability value. For example, when a DNA examiner testifies to a positive association between the questioned DNA (found, for example, on the victim or at the crime scene) and the defendant's DNA, they will explain to the jury that their conclusions are based on a random match probability (RMP). The RMP is the measure of how likely it would be to pick an unrelated

person at random from the population and for this person's DNA to match the questioned DNA. The RMP is often a very small number, such that the chance of finding another person who could have left the DNA is very small or negligible.

Previous research has investigated how jurors evaluate the strength of evidence presented in a narrative (or clinical) and probabilistic (or actuarial) way (Bayer et al., 2016, Krauss and Sales, 2001, Schweitzer, 2016). These studies have highlighted a preference mock jurors have for narrative or clinical testimony and that testimony presented in this way is given more weight than evidence presented in a probabilistic or actuarial form (Bayer et al., 2016, Krauss and Sales, 2001, Schweitzer, 2016). The results of this research of how Maine jurors evaluate the strength of the evidence supports the previous research and a tendency towards preferring narrative testimony was found.

Other researchers have hypothesized that the reason that narrative or clinical opinion testimony is favored by jurors over probabilistic testimony is due to the difficulty in understanding the weight of evidence when it is presented in a numerical manner (Thompson and Newman, 2015). It has been suggested that jurors, given the two styles of testimony, will take mental short cuts or heuristics and rely more on the credibility of the expert witness who testifies in a narrative form rather than try to comprehend the probabilistic or statistical testimony (Cooper et al., 1996, Greenberg and Wursten, 1988, Schuller and Vidmar, 1992). This is one of the possible reasons for favoring narrative testimony, however this research has highlighted another important possible reason.

Jurors in this study explained that it was important to them to be able to understand the strength of the evidence themselves rather than just trusting the expert witness. Jurors placed more weight in their decision making on forensic science testimony where the forensic science expert spent time teaching the jury about the steps they went through to come to their conclusion. Testimony where demonstrative aids were used allowed jurors to see how the expert came to their conclusion and in turn this gave jurors a deeper personal understanding of the evidence and more confidence to place weight on the evidence during deliberation. In the trials that formed the basis of this reach these "teaching moments" were part of the testimony of toolmark, fire debris, physical matching, fingerprint examiners and forensic pathologists. DNA examiners and trace examiners spent less time explaining the steps taken to come to their conclusions.

4.8 Limitations

As previously noted, the scope of this research is limited by the sample. The sample is small consisting of 29 jurors who participated in the paper survey and 22 jurors who participated in follow-up phone interviews. Sometimes the jurors did not answer all the questions and in these instances the sample size for a specific question would be smaller. The sample was made up of jurors who self-selected to participate and as such was not a randomized sample.

The vast majority of jurors who participated had third level education (Appendix

5). Many of the jurors reported working in professional careers where a Bachelor's degree or higher was needed. The education level of the jurors may have influenced their perspective of witness credibility or evidence reliability.

The juries in all the homicide cases, where expert witnessed testified in this study, returned guilty verdicts. Many of the jurors commented that the scientific evidence was important in their decision making.

As discussed in section 2.12 and Appendix 2, the expert witnesses who testified in these homicide trials all had 13 or more years of experience and as such would be considered seasoned expert witnesses. Given the comments of the jurors on the importance of the presentation of the experts it may well be the case that different results would be obtained if junior or less experienced experts had testified.

Research involving post trial surveying and interviews of jurors will always have limitations. It is very difficult to get the perfect sample that can represent the greater population. These limiting factors should be considered when applying these results to other populations and circumstances.

4.9 Conclusion

Jurors defined expert witnesses as individuals with high levels of training and

experience and a few jurors stated that a minimum number of years' experience was needed in order to qualify as an expert. In a few circumstances, jurors stated that an expert was 'licensed' by the jurisdiction they were testifying in and it was apparent that a number of jurors had interpreted the qualification of the expert to mean they had some sort of license to practice as a forensic scientist.

When describing the most important aspect of an expert witness's qualifications jurors rated university education, on the job training, certifications and years of experience as the most important. There was no one qualification that all jurors found important. University education was ranked in the top 3 by 79% of jurors, on the job training was ranked in the top 3 by 67% of the jurors and years of experience was ranked in the top 3 by 67% of the jurors. Forensic science is an applied science and the jurors appreciated the importance of years of experience. Interestingly, 80% of jurors ranked working in an accredited laboratory to be within the three least important criteria for credibility of an expert witness.

A juror's measure of credibility of the expert witness was based on the expert's demeanor, how they presented their evidence, their confidence and the perception that the State of Maine endorsed them. Jurors were impressed by years of experience and the qualifications of the experts, but also their presentation style. Jurors wanted to grasp and understand the evidence and visual aids helped them in this process. Forensic pathologists, Fire Experts and Fingerprint Examiners were rated the most credible expert

witnesses by jurors with footwear and tire experts being the least credible.

Jurors rated the forensic science evidence as very reliable 45% of the time, as reliable 44% of the time and somewhat reliable 11% of the time. Jurors based the reliability of forensic evidence on chain of custody, on how the evidence fit within a story and their perception of the 'uniqueness' of the evidence.

There is a moderate correlation between the jurors' interpretation of the witness's credibility and the perceived reliability of the evidence. The expert witness represent the science and the evidence they are presenting. The jurors for the most part did not seem to separate the credibility of the expert witness from the reliability of the evidence. Jurors reported 78% of the time that the forensic science testimony was the main factor in their decision-making.

These results indicated that the critical decision that a judge takes to admit scientific evidence in front of a jury has a direct impact on the decision making of the jury in the determination of their verdict. Jurors place an inherent trust in the expert's credibility and also on the reliability of the evidence they present. It is an important finding for judges, attorneys, trial consultants and expert witnesses that there is a statistically significant correlation between expert witness credibility and forensic evidence reliability.

This research has highlighted a potential weakness in the way Maine jurors evaluate and place weight on forensic science testimony. The determination of the strength of the evidence and the weight jurors placed on it was based upon the how well the juror understood the evidence and not on the validity or reliability of the evidence. This is a concern that has been highlighted by forensic science stakeholders and this research further highlights the lack of connection between evidence with established foundational validity and the interpretation by jurors of the strength of such evidence (Holdren et al., 2016, National Research Council, 2009).

CHAPTER 5: The influence of the trial processes and the CSI effect on juror decision making

5.1 Introduction

How jurors make decisions about the value of forensic science evidence is based on their own perceptions of the evidence and is also influenced by the dynamics of how small groups make decisions (Weingart and Todorova, 2010). This chapter outlines some of the previous research on small group decision making and how the trial processes, including the performance of the attorneys and the deliberation process can influence the jurors' perceptions of forensic science evidence. The CSI effect is introduced and the results of television watching habits of jurors and their expectations of forensic science evidence is presented.

5.2 Jury Decision Making Theories

The Condorcet's Jury Theorem was proposed in the late eighteenth century to explain the dynamics of jury decisions. The theory remains valid today and states that the collective decisions of a group (verdict) will be more accurate than the decision of an individual (Koch and Ridgley, 2000). Research has shown that juries arrive at correct verdicts more often than judges and this is attributed to the benefit of collectively evaluating the evidence (Caldwell, 1929, Hans, 2007). The process of deliberation is important to ascertaining how jurors place value on forensics science evidence. The

question remains, what conditions need to be present in order to maintain the integrity of this process?

Research on jury decision making continued in the 1950's with the Chicago Jury Project (Broeder, 1959). This study questioned jurors who sat on 3,500 criminal trials which resulted in a theory that group deliberation had little influence on verdicts. This study concluded that important changes did not occur during deliberation (Salerno and Diamond, 2010). The theory that the final verdict was just the sum of the parts of each juror's evaluation of the evidence, and deliberation was not influential, remained popular until further research was carried out in the 1970's which showed that the deliberation process is indeed very important in verdict decisions (Foss, 1976).

A third theory which has been applied to jury decision making is groupthink. Groupthink is a term coined by Irving Janis to describe faulty decision-making by small groups (Janis, 1983) and this theory has been applied to jury decision making over the past 30 years (Huitema et al., 2007, Mayo-Wilson et al., 2013, Mitchell and Eckstein, 2009, Neck and Moorhead, 1992, Sunstein, 2007).

The groupthink theory describes a series of group characteristics which can lead to the group to make inaccurate decisions, and groups which are cohesive, are particularly susceptible (Cline, 1983, Riordan and Riordan, 2013). The five risk factors for groupthink are:

1) Group cohesiveness
2) Insulation of the group
3) Lack of group norms which require a methodical approach to decision making
4) Lack of tradition of impartial leadership and
5) Group homogeneity.

The nature and structure of the jury make these groups susceptible to groupthink. Juries can become cohesive groups as they hold a major responsibility (returning a unanimous verdict) and are sworn to uphold this responsibility. They eat their meals together and spend a lot of time together. Juries are required to refrain from discussing the case while the trial is ongoing. This fosters discussion among jurors on commonalities outside of the trial, potentially leading to a more cohesive group structure (Mitchell and Eckstein, 2009). The jury can be described as insulated group as the process of sequestration (where jurors are prohibited from discussing the details of a trial with individuals outside of the jury and in some cases are asked to avoid media coverage of the case) temporarily separates them from the outside world, to ensure that their verdict decision will be based only on the evidence presented at the trial (Mitchell and Eckstein, 2009).

Juries are perceived as suffering from a lack of norms (rules of how to proceed) within the group and require a methodical approach to deliberations (Salerno and

Diamond, 2010). The jury has no established or methodological way of making decisions and when decisions fall prey to groupthink it is often due to a lack of a methodical approach to decision making (Mitchell and Eckstein, 2009).

With the risk factor, lack of a tradition of impartial leadership, the weakness in decision making lies with how the jury selects its own leader, the foreperson (Wilcox, 2010). There are no safeguards against this individual influencing the jury decision making. Groupthink theory suggests that without impartiality in the leader, faulty decisions can result. A final risk factor for groupthink is group homogeneity. This is a phenomenon where groups who lack social and educational diversity are prone to groupthink. This lack of diversity can lead the group to think as a unit and neglect alternatives and this can result in inaccurate decisions.

5.3 The Deliberation Process

Small group decision making applies to juries and other small groups, such as emergency room personnel, hiring and firing committees and SWAT squads, who are tasked with making important decisions where the stakes are high (Weingart and Todorova, 2010, Kovera, 2013). These groups experience tense environments where often a unanimous decision needs to be made in a relatively short length of time. Individuals in these groups will experience a push and pull effect between their autonomy and a need for group cohesion (Weingart and Todorova, 2010, Gouran, 1982).

In small groups where unanimous verdicts are required, people have a tendency to conform to group ideas or cluster their behavior within the group. An example of this is when investors justify compromises and invest in risky assets which in turn can lead to economic bubbles. Deliberation within juries, especially where unanimous verdicts are required, can lead to herding; justified compromises with misguided conformity, and verdicts based on conformity rather than sound judgment and consideration of all the facts (Baddeley and Parkinson, 2012, Neck and Moorhead, 1992, Mitchell and Eckstein, 2009).

The presence or absence of a jury leader or foreperson can influence final verdicts. The foreperson is selected by the jury and in some jurisdictions a foreperson is not required. The jury are given no formal instruction in how the foreperson is to be selected. Research has shown the foreperson is usually chosen quickly in an informal manner (Devine, 2012). The foreperson is usually a white male of higher education, higher status and the first person to speak or suggest that a foreperson be chosen (Devine et al., 2001). High socioeconomic status was a more significant factor for foreperson selection over gender, age or race (Feller, 2010) and jurors who reported on pretrial questions that they have taken a statistics class were over represented as jury forepersons (Diamond and Casper, 1992).

The question of when a verdict decision becomes fixed in the juror's mind is important. Does this happen early or late during the course of the trial or does the deliberation

process change or impact individual juror's decision making? Salerno suggests that jurors' views of the verdict are usually tentative at the end of the trial and the deliberation process is very important in the final verdict decision (de Paul Velasco, 1995, Salerno and Diamond, 2010). There is also some support in the literature to suggest that the decision to place weight on the scientific evidence is not simply a "pooling" of juror pre-discussion preferences but that real collaboration happens during deliberation (Clark et al., 2000).

Deliberation style can be broken up into two categories; verdict driven and evidence driven. Verdict driven juries take a poll early on and deliberate on the verdict options. The criminal justice system would prefer if jurors deliberated over the case facts and later arrived at a verdict (evidence driven). Pure evidence driven deliberations only happen approximately 35% of the time (Hastie, 1993) but these figures may be higher in cases where scientific evidence was presented.

Verdict driven juries may take an initial vote on the verdict before deliberating and the votes can be public or secret. Polling mechanisms have been found to have influence on final verdicts (Davis et al., 1988). Jurors do not usually take a pre-deliberation anonymous vote prior to beginning deliberation (Salerno and Diamond, 2010). Early voting, for guilty or acquittal verdicts, has an influence on verdicts. As each juror votes in sequence, subsequent jurors are influenced by earlier votes. For example, if there were 12 jurors voting, jurors voting later would be influenced by jurors who voted

before them. The presence of an influential voting leader may also lead to other jurors modifying their vote (Berg, 1994) and where the leader's views are inaccurate or faulty, his or her views can lead to an incorrect determination by the jury (Koch and Ridgley, 2000).

It has also been found that the longer the trial, the longer juries wait to cast initial votes (Diamond et al., 2003). Previous research also highlights that juries who polled at regular intervals were less likely end up as a hung jury and this suggests that individual verdicts change during deliberations (Devine et al., 2001).

5.4 The influence of attorneys and political affiliation on jury decision making

Juries are expected to treat defendants fairly and in theory, different juries presented with the same evidence should come to the same verdict. The criminal justice system does not expect factors outside of the evidence presented during the trial to have a significant influence on verdicts (Baddeley and Parkinson, 2012). If jury decision making is significantly influenced by factors unrelated to the evidence presented, this could jeopardize a critical part of our democratic system (Kovera, 2013). Factors which have been shown to influence jury decision making include, the performance of the attorneys, the formal procedures of the court (*voir dire*, opening statements, closing arguments and jury instructions) and the jurors political (Wood et al., 2011a).

5.4.1 Attorneys

Attorneys have an important role to play in introducing forensic science evidence through the expert witness. Both prosecution and defense attorneys must evaluate the testimony of the witness and ask additional questions of the expert in order to make sure the jury understands the evidence being presented. Previous studies suggest that the communication style (aggressiveness) and how persuasive the attorney was, influenced jury decision making (Linz et al., 1986, Miller et al., 2010) and a positive rapport between jurors and defense attorneys had a significant influence on verdict decisions that favored the defendant (Wood et al., 2011a). Other research found a significant positive correlation between how jurors perceived the preparedness of the trial attorney and the verdict. Attorneys who appeared to the jury well prepared for trial were more likely to favor the final verdict. (Wood et al., 2011b).

5.4.2 Political Affiliation

The literature suggests that political affiliation influences how and when individual jurors make a final decision on the verdict. Authoritarian personality types, often defined as right-wing or conservative (Verhulst et al., 2012) tend to decide on a verdict during the case in chief (when the prosecution is presenting the case) and the defense case usually does not change the original decision (verdict) of authoritarian jurors. These individuals tend to favor a guilty verdict. However, authoritarian personality types are

more susceptible to changing their original verdict after deliberations than non-authoritarian personality types (Bray and Noble, 1987). Other studies have focused on death penalty qualified juries, i.e. juries who are prequalified to consider a death penalty if a guilty verdict is reached. In these death penalty studies authoritarian jurors were more likely to vote for a guilty verdict at the conclusion of the trial and after deliberation (Piel, 2011).

5.5 The CSI Effect

The television series CSI: Crime Scene Investigation was first broadcasted in October 2000 (Shelton, 2008) and it wasn't long after that prosecutors started complaining that juries were acquitting defendants because the evidence presented at the criminal trial did not meet the jury's expectation for forensic science testimony (Shelton et al., 2006). In 2004 this expectation of forensic science evidence was given the term 'The CSI effect' (Willing, 2004) after the very popular CBS crime drama and other related shows based on fiction or true crime dramas (Shelton, 2008). How the CSI effect might influence juror decision making is of concern to the criminal justice system and for this reason there has been a lot of research into the topic (Cole and Dioso-Villa, 2009, Podlas, 2006, Schweitzer and Saks, 2007, Smith and Bull, 2012). Some of the research suggests that an individual's televisions viewing habits do not influence their expectation of scientific evidence (Shelton, 2010, Podlas, 2005, Podlas, 2006) where other studies have found weak correlations between an individual's crime show watching behavior and their expectation of forensic science evidence(Shelton et al., 2006). There has been no

conclusive studies that indicate that a jurors expectations of forensic science testimony influences final verdict decisions (Maeder and Corbett, 2015). These research studies surveyed mock jurors and individuals called to jury duty (prior to trial) and the question remains whether a juror's conscious or subconscious knowledge of forensic science, through television viewership, influences their decision making.

5.6 Results and Discussion from Juror Interviews

5.6.1 The Deliberation Process: Knowledge Sharing and Collaboration

Jurors were not asked specifically about the deliberation process, however, in response to other questions, jurors made comments about their experiences. The majority of jurors described the process of deliberation as being helpful to themselves or to other jurors in understanding the forensic evidence presented at the trial. In response to the question "What was your greatest challenge in evaluating the scientific evidence?" "Alana" stated:

> *"making sure they (the expert witnesses) brought it down to our terms. Of course, I don't think that I was the only one that got lost. There were some pretty smart jurors in there with me. We really bonded, we got to know each other really well. There were some brilliant ones in there. For me it was they needed to reword it and get it down to layman's terms."*

This indicates that some of the scientific evidence was difficult to grasp and that "Alana" benefitted from the collective knowledge of the other members of the jury. In

response to the question; “Do you think your level of science knowledge impacted your understanding of the scientific testimony?” “Amy” felt that it did. She described being more knowledgeable about the forensic evidence than some of her peers.

> *“I've got a medical background, so when the forensic people would start explaining things that were very basic, I'm trying to think of an example. What I'll just say is for most of the jurors, that was brand new information. I had that foundation, so I could take that foundation and take it one step forward, more critically because I didn't have to learn the foundation and take it to that next step. I felt like I was a little bit further ahead in that way. I'm trying to think of examples…Drug levels in a patient. It made perfect sense when they would say there were no metabolites, or there were metabolites. I knew what that was because I've got a science background, and I had a medical background. When they had to explain what a metabolite was, I already knew that part, so it wasn't like I had to master that information, and then master the next, the results behind it. My peers had to do both, so it was so much harder for them. I felt like they were taking notes on basic stuff, and I was taking notes on things that built on the basis. I just felt bad for them because they had to learn so much more during that trial than I had to.”*

“Gregory” explained that given his background as an engineer he understood the testimony about cell phone towers and explained this to the other jurors:

> *“of the jury pool, I was the only person that really understood the testimony about cell phone tracking and cell towers. If I would not have been on that jury, I don't think the rest of the people could have comprehended that”.*

It is clear that the deliberation is a dynamic process where jurors educate each other and fill in gaps or misconceptions that may arise in jurors' understanding of scientific testimony. Harold described the benefits of information sharing as:

> *"it helps if there are some extra witnesses that can help you make a proper interpretation and, in my case, I think also, your fellow jurors. When you're deliberating, they have opinions or points of view that can be very helpful in determining whether a piece of evidence was relevant and how relevant it was."*

"Martin" summarized how the forensic evidence was discussed by the jury and how the deliberation process was an important step in their collective understanding of the forensic evidence.

Researcher: *"Was it helpful to other jurors, and to yourself, to discuss the scientific evidence?*

"Martin": "*Yes. It was good because we had the evidence box with us, so we could look at different things. We could discuss certain things. Some of us might have very detailed recall, others not, so it was effective to have resulting conversations so everybody was on the same page, to make sure. As we deliberated and having the evidence there, it was pretty good having a good cross section. It was interesting too, by looking around the room there were younger people, middle age people, older people, male, female. There was a really good cross section of our Maine culture and our Maine society, and I felt like they all contributed."*

5.6.2 Difficulty Remembering the Scientific Information

Jurors described some of the difficulties they experienced during the deliberation process. One of the issues mentioned was trying to remember the evidence days and in some cases more than a week after the expert testified. "Amy" described the benefit of being able to take notes during the trial and how this assisted the jury when deliberating:

> "*The other thing I think that was unsettled was the timeline, particularly around text messages and phones, and the sequence of events. They (the attorneys) put the evidence and witnesses and the forensic people in order, in a way, but they didn't summarize it all that well. It really required us when we got back in the jury room to really start taking all the evidence again, and start trying to figure out a timeline, and figuring out where were they, and where was this, and does this make sense, and does that fit here? I think they could have done that better, put all the evidence together, and reinforced it a couple of times. We were lucky enough to be able to take notes.*
>
> *The notes were key, so when we started deliberating, people would have stuff in their notes, and then we would discredit it, or we'd ask to have things we read, or to read parts of the transcript*"

"Justin", in a different trial had a similar experience with difficulties remembering the evidence:

> *"The one thing that was hard for me and I almost wanted to put up a flow chart of*

the dates and the evidence that was being presented ... You could bring a pad or paper and everything, but it didn't seem like it (the presentation of witnesses) was highly organized, just bringing up people, bringing up issues and then you had to hold that and as a jury have to reassemble everything that was said. I guess that's what deliberations are, but it wasn't helpful."

Note taking by jurors is permitted in Maine criminal and civil trials (Rule 24 (f)). In only 2 of the 9 trials represented in this study were the jurors permitted to take notes. The jurors who were not allowed to take notes described more difficulty remembering the evidence, especially in one case where the trial went on for 3 weeks.

> **Rule 24 (f) Note-Taking by Jurors:** *The court in its discretion may allow jurors to take handwritten notes during the course of the trial. If note-taking is allowed, the court shall instruct the jury on the note-taking procedure and on the appropriate use of the notes. Unless the court determines that special circumstances exist that should preclude it, jurors should be allowed to take their notes into the jury room and use them during deliberations. Counsel may not request or suggest to a jury that jurors take notes or comment upon their note-taking. Upon the completion of [sic] 63 jury deliberations, the notes shall be immediately collected and, without inspection, physically destroyed under the court's direction* (MAINE RULES OF UNIFIED CRIMINAL PROCEDURE, 2015).

5.6.3 Jurors' perspectives of how the Trial Attorneys presented the forensic science evidence

Jurors were asked to evaluate how well the attorneys presented the forensic science evidence at the trial (Appendix 5, Question 10). The jurors, for the most part, reported being satisfied with how the lawyers dealt with the scientific evidence. "Martin" described how well the scientific information was presented:

> *"I think that things were pretty detailed driven. I mean there was a lot of information and there was a lot of detail, and I thought that the defending attorneys and prosecuting attorneys really asked good questions that would lead the expert witness to give valid and important information. I felt very comfortable with the information that was being given. There were some things that I was thinking about the trial that I felt maybe on Tuesday that would've been relevant, but by the time Thursday came to deliberate, we definitely had all the rules and all the information we needed to make a decision."*

"Amy" struggled with understanding some of the scientific evidence and the prosecuting attorney recognized the complexity of the testimony and asked follow-up questions to clarify the information for the jury. Amy said:

> *"what I struggled with was that they (scientific witnesses) used really big long scientific explanation with big long science words, I couldn't keep up. But then the lawyers would make sure that they brought it back to our understanding. It would have been over my head. The lawyers, especially the lady lawyer (prosecutor), she was very good, could you explain this to me again, did you mean this or this. I was like yes, thank you!"*

"Larry" was highly impressed with how the prosecution presented the case:

> *"I thought the Maine state police and all of their support staff along with the state medical examiner and the senior legal counsel representing the state did a phenomenal job. Their evidence was extremely well managed and well-presented and that's just my feeling."*

Some of the jurors described the questioning of expert witnesses as being too repetitive. In an effort to build a case and meet the burden of proof, the attorneys need to make sure all the evidence is clear to the jury and in some cases the jurors felt they understood the information and additional questions were not necessary. "Larry" described how he felt about the excessive questions:

> *"I think they asked, the prosecution attorney asked so many questions I was getting impatient with it all. They covered it so in depth that I, I'm a business man, I felt like we had that all answered and then we went from one professional (expert) to another. I'm surprised that splatter person, I'm surprised some of these specific functions can't be consolidated into one. I thought we went overboard on the State proving, but I don't know, at least they did it. The others (defense attorneys) didn't do anything. I thought that built the case immensely."*

"Gail" felt the questioning of experts was repetitive but appreciated that it was part of the process of introducing evidence:

> *"There was a couple questions that weren't asked that I was wondering why they didn't, but I can't remember what they were now. They did a great job as far as bringing out what they had to bring out. A lot of the things that they asked were*

repetitive but I guess you have to do that."

For some jurors the amount of repetitive questions caused them to see the attorney in a negative light. "Dana" felt the excessive questions, asked of a trace evidence examiner, about the location of sperm cells on a homicide victim were not relevant to the case and were unnecessary:

> *"They asked a lot of questions. The questions of where the sperm cells were found, anal versus vaginal had no bearing on the murder and were unnecessary"*.

"Dorothy" described a prosecutor who asked so many repetitive questions that he was viewed in a negative light:

> *"I wasn't really keen on the prosecutor who kept repeating himself over and over and over and over and it was like he was trying to convince everybody that the (defendant) was guilty by verbal beating. I don't think they put on a real logical defense but I fell asleep once. You don't need to rely on me. That might have been because the guy was saying the same thing over and over and over and over. "*

Jurors commented on how the attorneys presented the evidence during the trials. Visual aids are helpful to the jury, but one juror commented on how the prosecutor asked a medical examiner to demonstrate, using a pointing stick, the angle a bullet might have entered the body. The demonstration was theatrical in court and appeared poorly prepared. "Damon" described the demonstration:

"Although I don't think the prosecutors helped her any, the way they made her show the angle. I would've drawn a picture of the neck and two views of the neck and then you didn't have to have anybody up there (demonstrating). You could've drawn a picture of a head, no matter how it looked, and a picture of a neck and then showed that going through it at this angle and then draw it in one more view, of the front view, then you could get the idea where that was going through."

A few jurors had suggestions on how the attorneys could have made their job easier. One juror felt the presentation of witnesses and introducing the different aspects of the crime could have been more organized. He suggested a timeline would have been helpful for the jury. "Justin" said the way the case was presented:

"didn't seem like it was highly organized, just bringing up people (witnesses), bringing up case issues and then you had to hold that (information) and as a jury have to reassemble everything that was said. I guess that's what deliberations are, but it wasn't helpful. The one thing that was hard for me and I almost wanted to put up a flow chart of the dates and the evidence that was being presented."

*"*Amy" suggested a timeline as well:

"I think what was unsettled was the timeline, particularly around text messages and phones, and the sequence of events."

"Amy" suggested that the closing arguments could be used more efficiently. She would have liked the attorneys to summarize the evidence in order to make the deliberation process easier for the jury.

"*The closing statements seemed more pedantic to me. The attorney was up there and trying to grand stand, and choose me, sort of things, versus basically reinforcing and summarizing, doing the work for the jury, I guess is where I'm coming from there. Now, one more time, they should have come up with their theory and the evidence to support every piece of their theory, so that by the time a jury got into the room, then they can poke holes in that, or they can support that. Instead, what happened is we had to go back in the room and do it ourselves, which took more time and allowed for people to poke more holes into it, and just overthink. I think being less pedantic, or not pedantic. That's probably not the best word, but less grandstanding and more just reinforcing what we've learned and why each piece of evidence fits in with exactly how we feel it went."*

5.6.4 Jurors' Perceptions of Poor Prosecution and Defense Strategies

Jurors also commented that some of the prosecution and defense strategies of questioning the forensic scientists distracted from the evidence. "Alana" and "Amy" who were part of the same jury both described how the defense attorney's questioning of the expert witnesses was ineffective.

Researcher: What did you think about the way the lawyers dealt with the scientific evidence?

"Alana": *I didn't like either lawyer at all. I really didn't like one and I don't know which one it was but no, I don't like the way they put the experts down, they demeaned them, they were belittling, they were, this one in particular was extremely sarcastic. I wasn't happy with any of that at all.*

Researcher: Did the lawyers ask the questions that you needed and wanted to know?

"Alana": *Yes and no. There was a lady lawyer (prosecutor). She was very professional and asked what I call the real questions, the right questions. The lady lawyer was awesome. I don't know how to answer that. I think she did.*

"Amy" described how one defense lawyer's communication with the forensic science expert was distasteful:

> *"To be honest, I will be very honest with you that (talking down to the expert witness) annoyed the jurors more than anything. There was one particularly one of the lawyers did that more than the other. He was very pomp and circumstance, and he would talk down. He would almost remind me of how you would act towards a child, where you talk very slow and you mouth your words. I think the jurors felt that they were annoyed by him because of that, whereas the other lawyer spoke to us as if we were peers."*

"Leon" and "Matthew" in different cases described the tactic of portraying the defendant as the victim and the decedent as the attacker as an implausible explanation of the forensic science evidence.

"Leon": *"I thought the defense team were very weak in defending the defendant. The toy nunchucks were a very poor example of a weapon that someone (defendant) would be afraid of. I was not convinced that the defendant would feel threatened by what looked like a toy."*

"Matthew": *"I think that the defense lawyers were (the defendant's) worst enemy. He had horrible lawyers. Horrible. When you confess to a crime and they (the police) audio record it, and they Mirandize you and everything, and then (the lawyers) come up with this crazy story of this man that outweighs this woman by 100 pounds and has domestic violence histories, he's just a poor guy that got caught up in a bad situation and blah, blah, blah. In my mind, there had to have been a better way to defend this fellow, if that's your intent. I don't know."*

"Matthew" also brought up an issue that the jury recognized in one of the defense expert witnesses. He described a situation where the defense expert witness was only given partial information about the crime scene and blood evidence. Under cross examination by the prosecutor the testimony was discredited.

"Matthew" *"Here's a bungle-up that the defense team did. They hired their own expert witness on cuts (stab wounds); whether they are in self-defense or are they cuts congruent with somebody trying to put their hand up and grab a blade and get it out of their face or is this cut probably got by accident; I cut myself while I'm trying to stab her to death. The guy that the defense hired, he gave his opinion and then upon cross examination he was asked, well did they (the defense team) tell you this, did the defense disclose this to you or that to you, and he said no. They asked him if that would change his findings, and he said absolutely. He only got the part*

of the story they wanted him to hear."

Two jurors attributed the inability of the defense attorney to discredit the forensic science evidence, through cross examination, on the ability/experience for the attorney. There was a perception that the lawyer was a public defender.

"Larry": *I think the defense attorneys, I speak openly, I think they were terrible in this particular case. I think they were just horrible. I don't know if they were public defenders or I've seen them on the news since handling some other cases and I just thought they were horrible. I just thought the gentleman being tried was very poorly represented.*

"Dorothy": "*I thought I could tell that the defense lawyers were public defenders because they didn't put on a particularly rattled defense I didn't think. The prosecution was nasty and they felt like (they) "had him" without doing an awful lot of work"*

5.6.5 Political Affiliation

Jurors were asked about their political ideology on the survey (Appendix 4, Question 11) and Figure 30 illustrates the range of Jurors' political affiliations.

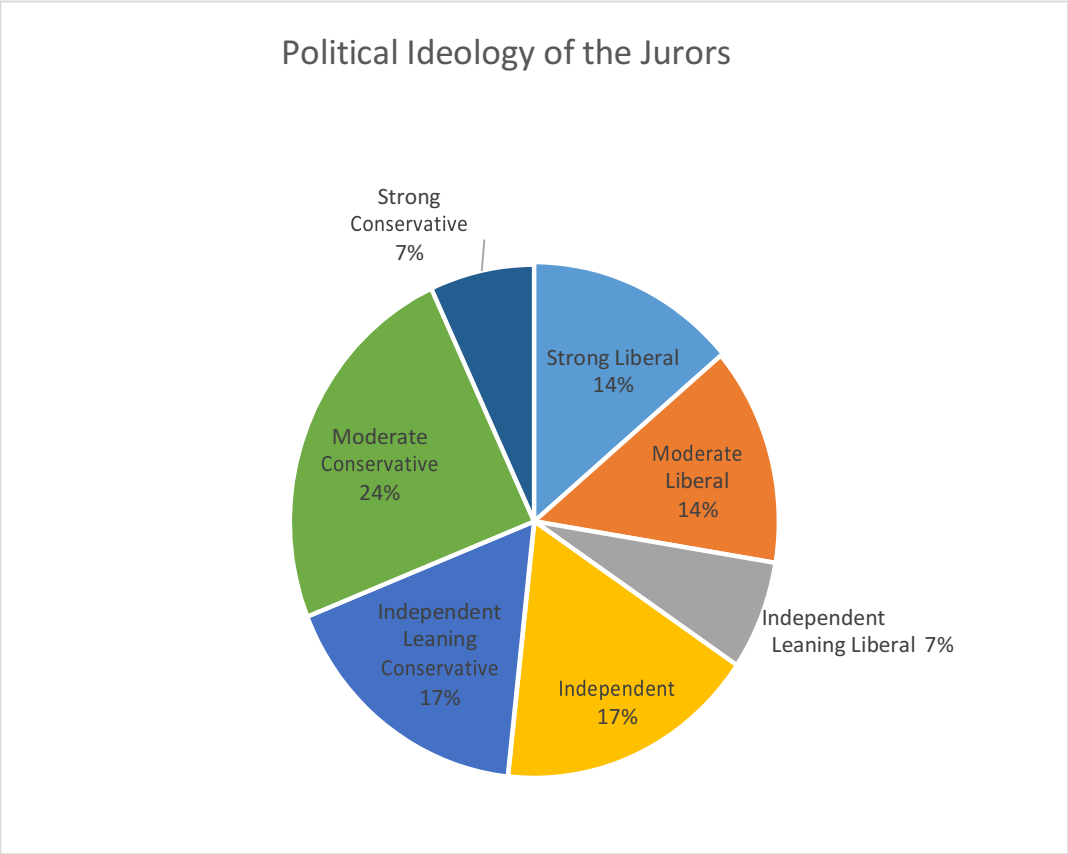

Figure 30: The range of jurors' (N=29) political affiliations

Jurors were asked (Appendix 4, Question 12) if their political affiliation influenced their decision-making in relation to the expert testimony. One juror, or 3% of the population, stated that their political affiliation influenced how much weight they placed on the expert testimony. All the other jurors reported their political affiliation did not influence decision making. As these finding come from self- reports from the jurors, the results need to be considered carefully. Jurors may have been influenced by their political ideology and not have known it or may not wish to report this on a survey (Podsakoff and Organ, 1986). When asked whether the deliberation process helped clarify any questions about the scientific evidence, one juror commented that he had

made up his mind about the verdict prior to deliberations. This juror identified as a moderate liberal. There was no further investigation relating to political affiliation and decision making, due to the judicial constraints limiting these enquiries.

5.6.6 Keeping up with Current Events

Jurors were asked on the survey how they keep informed of the news and current events (Appendix 4, Question 8). Most jurors reported getting their news from two or more sources.

All jurors reported using newspapers, online news sources, news from the television and by listening to the radio. No one particular news sources were used more than the others (Figure 31). None of the jurors reported that they did not keep up with the news.

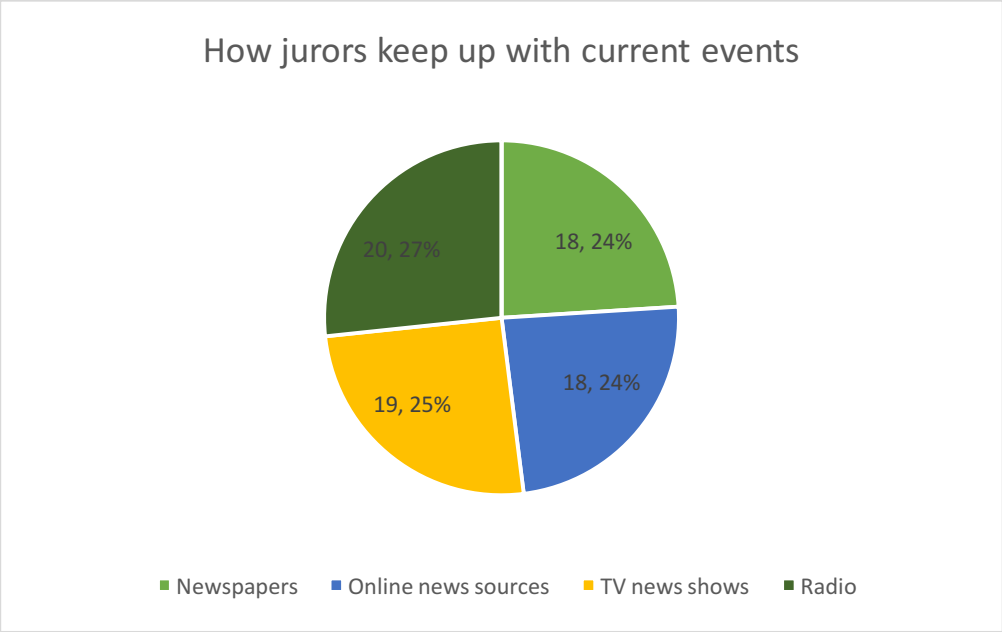

Figure 31: How jurors keep informed of news and current events

5.6.7 TV Watching Habits

Jurors reported the quantity of time per week they spent watching entertainment on the television or streaming online (Appendix 4, Question 7). All respondents reported watching some television (Table 10 and Figure 32).

Table 10 : Time Spent Watching Television

	Survey		Phone Interview	
Less than one hour	4	(14%)	3	(14%)
1-4 Hours per Week	8	(28%)	7	(32%)
5-12 Hours per Week	15	(52%)	10	(45%)
More than 12 Hours	2	(7%)	2	(9%)

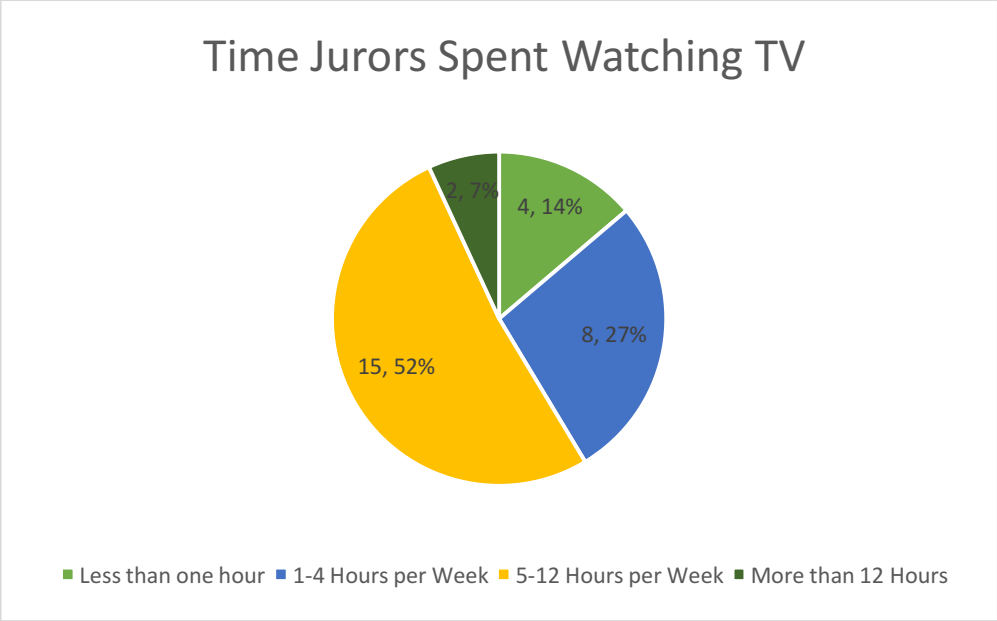

Figure 32: Jurors' time spent watching TV

Jurors were asked how many hours they spent weekly watching crime themed shows, such as CSI, Law and Order, NCIS, Forensic Files or Murder Detectives (Appendix 4, Question 8). The majority of jurors, 76%, reported watching less than 1 hour of a crime show per week and 14% reported not watching crime shows at all (Table 11 and Figure 33).

Table 11: Time Spent Watching Crime Shows

	Survey		Phone Interview	
None	4	(14%)	3	(14%)
Less than one hour	22	(76%)	16	(73%)
1-4 Hours per Week	3	(10%)	3	(14%)

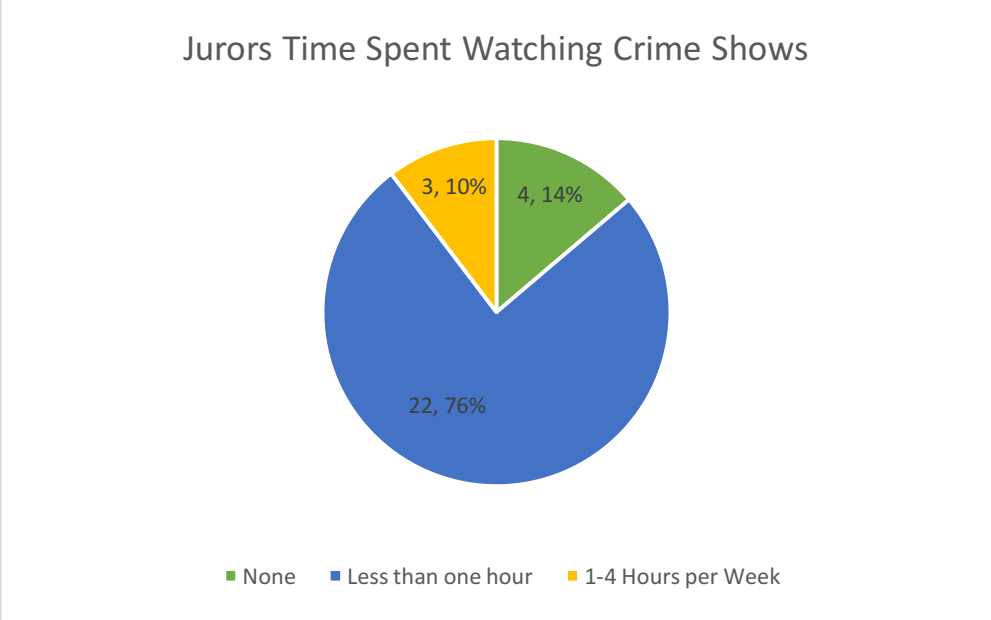

Figure 33: Percentage of time jurors report watching crime shows

5.6.8 The CSI Effect?

When asked how closely crime shows represented reality (Appendix 4, Question 9) 59% of jurors believed the crime shows were close to reality to some extent. 17% did not believe the crime shows represented reality at all and three people, or 10%, thought the crime shows represented reality to a large extent. These results are illustrated in Table 12 and Figure 34.

Table 12: How close to reality are the crime shows

	Survey		Phone Interview	
Not at all	5	(17%)	2	(9%)
To some extent	17	(59%)	13	(59%)
To a large extent	3	(10%)	3	(14%)
Don't Know	4	(14%)	4	(18%)

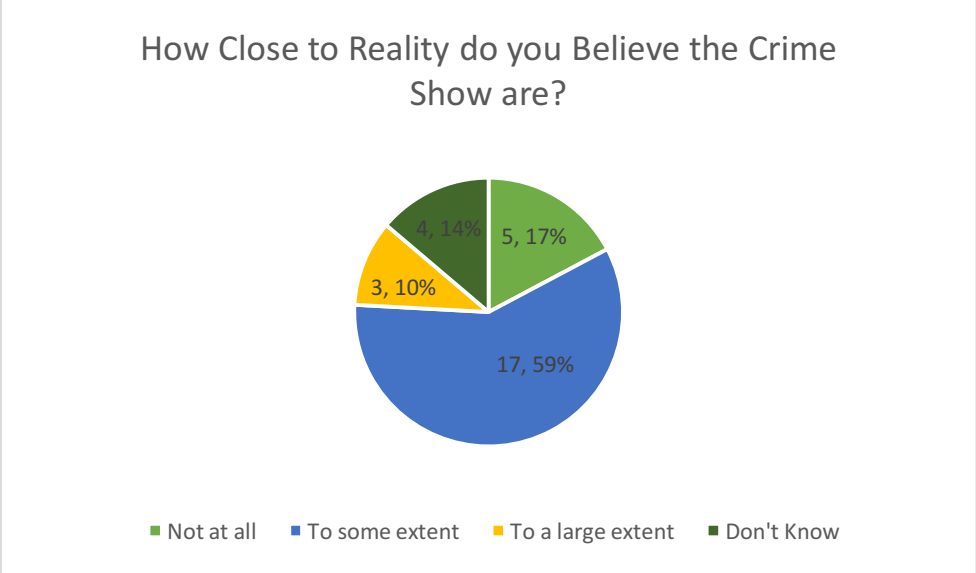

Figure 34: Percentage breakdown of how close to reality jurors believe crime show to be

Jurors who watched more crime shows or who felt the crime shows were close to reality were asked whether they had an expectation that additional forensic tests would be undertaken (Appendix 4, Question 16). All 22 jurors who were interviewed indicated that they did not feel there was any additional forensic evidence or test that they were expecting, however a few jurors expressed irritation that DNA was not found even after samples were tested. “Larry” stated:

> *The only thing that I was a little miffed about in the trial, I thought there would have been more conclusive DNA evidence. I thought probably DNA evidence on the pipe would have been more conclusive. I was very surprised that there wasn't more conclusive DNA evidence. I thought that would have been kind of slam dunk stuff but water dilutes and contaminates that beyond its credibility I guess. I would have thought in this particular trial there would have been more concrete DNA evidence presented by people than was presented by any in the case. I guess that's my lack of knowledge on how DNA evidence sustains itself or something. I don't know.”*

The DNA expert testified to the lack of the defendant’s DNA on a particular weapon. “Larry’s” statement suggests that he had an expectation that the DNA evidence in his case would have been more help during deliberations. And a few jurors reported having other questions unrelated to the forensic testing. “Amy” commented:

> *I thought the crime scene evidence was really good. I don't think that there was anything missing there. I think there were a lot of subtle details in relation to the guns, and I think they could have helped the jury come to the conclusion they should have better with that. I think because they left a little bit of it*

unsettled, and I think that created a little bit more chaos for the jury, because we spent more time trying to settle those issues than if we had just really deliberated. The other thing I think that was unsettled was the timeline, particularly around text messages and phones, and the sequence of events.

Jurors were asked to describe how they felt science was portrayed on television and how close to reality they thought the crime shows were (Appendix 4, Question 10 and Appendix 5, Question 15). Jurors described how the crime shows over simplified how forensic tests are carried out. In particular, a few jurors thought that the speed of results was unrealistic. " Gregory" described how DNA is portrayed on some of the crime shows:

"I think it's portrayed that it's a lot easier and a lot faster than it is, and that it's not more accurate but ... It's portrayed as being a lot simpler than it is. A lot of people just assume that if you brush up against a wall, they can do DNA on that in an hour and know that it was you because it speeds the show up. They don't realize that it may take weeks or months to get DNA evidence back or the same way like, because of what I do for a living, I watch these shows and they talk about how they track people with cell phones or all this weird stuff they do, and it's totally false.

Jurors made statements that indicated they used knowledge of forensic science learned through watching TV in the trial. A representation of these comments is below:

"Harold": *Largely the press has educated us that this testing (DNA), if proper samples can be secured, is extremely reliable*.

"Mark": *There have been articles casting doubt on forensic DNA analysis. However, in this case with a small number of unrelated people involved there would be no confusion.*

"Dana": *I think fingerprints are reliable, DNA, hairs, that's what I have seen on CSI.*

"Charlotte": *I guess my knowledge of genetics and testing, is more based on popular culture things like TV shows*

"Justin" (in relation to fingerprint comparisons and AFIS*) "I thought with like CSI, you had a computer that went through and matched 100%, but that's not what happened.*

Some of the jurors felt that the way science was presented on the crime shows was close to reality. "Charlotte" described not knowing how close to reality the science of the crimes show is depicted:

> *"I would say, again not knowing a lot about science in general, especially natural science, I probably find the portrayal of like the scientists convincing. I find their evidence pretty convincing, what they have to say about DNA testing or whatever, but I don't know how close that actually is with reality, how accurate it is."*

Researcher: *What was your opinion on how science is portrayed on those crime shows?*

“Dorothy”: *Oh they look like they're brilliant miracle workers. I don't believe that they have people that are that genius.*

Researcher: *What parts on the shows do you think are believable, or unbelievable?*

“Dorothy”: *My guess would be that probably people with experience with guns are probably believable, unfortunately. And people that have considerable experience with DNA of which they're probably not very many. I can't imagine that many police departments can afford the equipment that they would need.*

In response to the same questions “Grace” said:

“*Every now and then, I see CSI. That's convincing to me when they can match a DNA, match a hair from this location, match it with this guy. What’s convincing to me is DNA and forensics.”*

*“*Justin” and “Larry” did not distinguish between science on TV and in reality. In response to the question of how science is portrayed on TV “Justin” answered:

“Infallible. That’s the way I ... the same thing with Bones, the few shows I watched. They are wicked smart. They could just piece things together and it was done.”

“Larry” stated:

“I think it's believable. I think when you take a show like NCIS and they have a medical examiner I think we as laypeople, at least I do, think that a medical

examiner is, that's their expertise and they offer some very worthwhile information."

"Martin" felt that the crime shows contained some valid information:

> *"I think they try to focus on the science side of things pretty well. There is still some good valid information on some of those shows."*

This qualitative data does not support or refute the idea off a "CSI effect". Additional research is need to establish if the CSI effect exists. Some jurors are clear on the difference between science on TV and real science, but for other jurors the separation of entertainment and reality is less clear.

5.7 Limitations

The greatest limitations with the data were due to constraints established at the outset of the research, by the Chief Justice of the Maine Superior Court System. Jury research brings with it risk and every effort has been made to minimize risk to the jurors and to the Courts. Only one question, asking if the deliberation process helped jurors understand the scientific evidence, was used, and this question was agreed beforehand with the Chief Justice.

Whether the juries in this study were influenced by the processes described in groupthink is unknown and could only be determined if video recording of deliberations

were to take place as they do in other states (Hans et al., 1998).

Other limitations include the small sample size of 29 survey respondents and 22 phone interviewees. The research was limited to homicide trials in Maine, so the jurisdiction was narrow.

The sample was made up of self-selected jurors and there was a 45-60 day lapse in time between the end of the trial and jurors filling out the paper survey.

5.8 Conclusions

In the majority of cases jurors reported that the attorneys did a very good job of presenting the scientific evidence in a manner that was easily understood and helpful to them. A few jurors would have liked a summary of the events and evidence presented to them in during the trial. Jurors in 2 trials were allowed to take notes and they commented that the notes were a helpful memory aid of the scientific testimony, especially after trials of a few weeks. It is recommended that judges in jurisdictions where notes are legally permitted allow the jurors to take notes. Previous research has found that note taking is neither a distraction to jurors during the trial nor does it cause unnecessary influence in deliberations (Heuer and Penrod, 1994, Heuer and Penrod, 1988).

Jurors described the questioning of the scientific witnesses as very repetitious and attorneys need to be aware of the manner in which they question witnesses in order to minimize unnecessary repeated questions and to maintain the jury's attention. There were also some negative comments on how the attorneys questioned the expert witness. It can be concluded from this research that jurors do not appreciate it when attorneys belittle the expert witnesses. To make their point attorneys should follow an alternative strategy, especially when the jurors have decided in their mind that a witness is credible. In a few cases, where the prosecution's case was very strong the defense team portrayed the defendant as the victim and the decedent as the aggressor, this strategy appeared to have backfired. Attorneys may find these comments useful in designing a trial strategy in the future.

Jurors reported that they kept up with the news and events by reading newspapers, accessing online sources, watching the television and by listening to the radio. No one source was used more than others. Half of the jurors reported watching TV 5-12 hours per week and only 10% (3) reported watching more than 1 hour of crime shows. The CSI effect theory suggests that jurors have unrealistic expectations of forensic evidence and also have expectations of additional testing not presented at court. While jurors in this study did not have any expectations of additional scientific testing, there was moderate support for a connection between watching crime shows and how this colored the jurors' view of the forensic science evidence presented at the trial. Many of the jurors were able to distinguish the difference between how

science was portrayed on TV and how forensic science worked in reality. Two (10%) jurors reported that the way science was portrayed on the crime shows was, to a large extent, close to reality. This suggests that some jurors may have unrealistic expectations of forensics science evidence.

Jurors reported their political affiliations as ranging from strong liberals to strong conservatives. There was no evidence to suggest whether the jurors' political affiliations did or did not influence decision-making.

Jurors made comments on the deliberation process and it was clear from the jurors' reports that the deliberation process was very helpful in understanding and putting weight on the scientific testimony. This study indicated that deliberating is a dynamic process where jurors collaborate and share information. This supports previous research which reported that deliberations are much more than the sum of individual juror verdicts or a simple pooling of ideas (Salerno and Diamond, 2010) Jurors work very hard to come to the correct verdict based on the evidence and often the deliberation process was described as causing jurors stress.

CHAPTER 6: Conclusions

6.1 Information Processing and Cognition: How do the Jurors do it and what can go Wrong?

Researchers of juries are interested in how the jurors process and assimilate the information they hear and learn throughout the course of trial. It is hoped that by gaining a better understanding of how jurors piece together the information so that the major players in the judicial process can be better informed. For the judge this might mean instructing the jury about how to apply legal rulings to court testimony. Prosecuting and defense attorneys need to know how jurors process the trial information in order to present evidence in an order and manner that will best serve the jury, defendants and victims.

Defendants may have the option of forgoing a trial and accepting a plea agreement or waiving their right to a jury trial. The defendant will make this decision given a particular view of how a jury would judge the evidence if it were to be presented. A victim might also be interested in knowing how jurors will view the evidence as this can guide his or her expectations of the trial outcome. Finally, expert witnesses also need to be aware of how jurors comprehend and process information in order to present evidence in a logical and easily assessable way.

Earlier research suggests mathematical models to explain how jurors comprehend evidence presented to them at court. Most modern research has favored Hastie's story model approach for explaining how jurors interpret information and make decisions (Hastie et al., 1983). The story model suggests that jurors bring with them to the trial, an individual world view, and this is not set aside as the juror hears the evidence or deliberates. This world view, along with the testimony presented at court, colors how the juror interprets and places value on the evidence.

The question of how jurors assimilate forensic science evidence into the other narrative information associated with the trial and how this might influence their decision making was posed in Research Question 1. This research strongly supports the story model of juror decision making. The jurors themselves described during the interviews how evidence that fit within a story was determined to be more reliable and more valuable than evidence that did not. Jurors questioned the reliability of testimony that did not fit with the story that they had pieced together in their mind. The juror's world view is a factor that influences the weight they place on forensic science evidence through the cognitive process of assimilating evidence known as the story model.

Research Question 2 queried whether jurors correctly understand the testimony of the forensic scientist and if they place the appropriate weight on the evidence given the testimony?" Previous research has shown that a strong predictor of jury verdicts is

the strength of the evidence (Devine, 2012, Devine et al., 2001). In following the strength of the evidence jurors place more weight on testimony that has a strong inculpatory or exculpatory impact on the case and when evidence appears weaker, jurors place less weight on it. This research supports the theory that juror decision makings follows the strength of the evidence, which suggests verdicts will make sense with the evidence that is presented in court. Jurors in this study indicated that the testimony of forensic scientists who linked the defendant to the crime scene or to the victim through evidence, such as DNA, fingerprints and physical matching was rated as being very important in their decision-making. Less important in their decision making was expert testimony that did not definitively link the defendant to the scene/victim. Examples of less important evidence was testimony from footwear and tire examiners who testified to weak associations between the defendant's shoes or vehicle and the crime scene. Also less important to juror decision making was testimony that gave an overall picture of the crime scene or testimony that described the conditions of the scene. An example of this was testimony given by a fire debris expert who confirmed that a fire which had destroyed evidence of a homicide, was started intentionally.

Jurors' education and cognition are often questioned in cases where complex testimony is presented and especially when a jury delivers an unexpected verdict (Butler and Moran, 2007, Horowitz et al., 2001, Jonakait, 1991). The purpose of the jury is to represent society and also act as a buffer between the defendant and the judicial system. Jury experts describe two ways jurors process expert testimony to arrive at a decision as

to how reliable the evidence is. Jurors in this research study predominately described engaging in active central processing of the scientific evidence. They evaluated the evidence, questioned the results and explained it to other jurors during deliberations. The majority of jurors reported not having any difficulty understanding the scientific evidence presented at the trial. Peripheral processing can occur when jurors do not understand, or are for some other reason, disinterested in, the testimony.

Remarks made by a few jurors highlighted the fact that complex testimony does indeed trigger peripheral processing. In cases when jurors did not understand the scientific testimony they relied upon other factors in order to establish the reliability of the evidence. Some of the jurors commented that they based the reliability of the complex testimony on the expert witness's credibility. This is an important consideration for expert witnesses and for the judge. Expert witnesses need to be aware that jurors are not simply satisfied to hear the expert witness's conclusions, but the jurors in this study described a need to be taught or shown how the expert arrived at the conclusion. From the judge's perspective, as the gate keeper, peripheral processing is of concern. If the judge allows expert scientific evidence of questionable reliability based on admissibility standards, they must be aware that the jury may not understand the evidence and may base the reliability of the expert's conclusions on the credibility of the expert.

6.2 How do Jurors Determine Credibility of an Expert Witness?

Research Question 4 sought to answer the question of how jurors determine the credibility of the forensic scientist they witnessed at the trial. Across all disciplines in this study, jurors rated forensic science witnesses as "very credible/ credible/ somewhat credible" 54%, 45% and 1% respectively. Jurors described the credibility of an expert witness as being based on a number of factors; the expert's demeanor and how they presented the evidence. Expert witness confidence on the witness stand translated to credibility in the jurors' minds.

Expert witness credibility is very important as the expert speaks for the evidence that they are called upon to explain or clarify for the jury. Establishing credibility with the jury needs to come before the expert speaks about the evidence. The jurors in this study used the number of years' experience the expert witness had gained, as well as their qualifications, to establish credibility. This supports hypothesis 2, that jurors view the experience and formal qualifications of the individual expert witness certifications or whether they work in an accredited laboratory. This indicates that the process of qualifying an expert before they testify about the evidence is necessary and very important for the expert and the court.

This study shows that jurors place strong value on the knowledge of the forensic

scientist. This is important information for crime laboratory management and those who hire and retain scientific experts. Today in 2016, the Federal government in the United States is moving forensic science towards universal standards in processing methodologies, conclusions and ultimately to national credentials for forensic scientists. These are important steps in promoting quality in forensics science, but jurors are evaluating the expert witness on their experience and expertise.

Laboratory accreditation will in the future be necessary to apply for and secure federal funding. While these policies and procedural changes are a step in the right direction for forensic science it is very important to keep the jury in mind. This research suggests that should be made more aware of the benefits of laboratory accreditation and continuing education of expert witnesses.

6.3 Reliable Scientific Evidence, from a Juror's Perspective

Research question 4 sought to answer the question as to the factors which influence jurors' perceptions of the reliability of forensic science evidence. Jurors were presented with a wide variety of evidence types during the course of the homicide trials in this study. Jurors did not view all the forensic science evidence as equally reliable. The breakdown of how reliability was rated across the different disciplines is presented in Figures 12-18 on page 108.

The jurors based the reliability of the evidence on chain of custody, on how the evidence fit within a self-constructed story (the story model) of how the crime occurred and the importance of the evidence or how closely the defendant was linked to the crime scene or victim. We see that jurors are aware that chain of custody is a really important factor in evidence reliability. On the other hand, when jurors base the reliability of evidence on how it fits with the overall picture of the case in the juror's mind, this opens up the possibility for important and reliable evidence to be down-graded or set aside by the juror if it does not appear to fit within the story. Another weakness of basing reliability of evidence on how it fits a story, is that weak or unreliable evidence may be perceived as reliable if it fits well within a constructed story.

When jurors report that the reliability is based on how unique or important the evidence is they are connecting reliability to the strength of the evidence. Evidence that strongly links the defendant to the crime scene/victim is therefore perceived as reliable. Most of the time this approach to determining reliability may not cause concern. However, if the testimony is based upon science that has questionable reliability, then testimony by an expert linking (or excluding) a defendant from the crime scene may be perceived as very reliable evidence and may play a large role in decision-making and verdicts.

Previous research has suggested that jurors favor and put more weight on clinical

or opinion testimony than on statistical conclusions. In a study of mock jurors it was found that they rated DNA more accurate than fingerprints, hairs, eye-witness and victim testimony (Lieberman et al., 2008, Krauss and Sales, 2001) however in another study it was found that DNA has a larger effect on guilty verdicts than the defendant's confession but not a larger effect than fingerprint evidence (Briody, 2004).

On face value this research provided moderate support for juror preference to subjective clinical testimony over statistical conclusions. Jurors rated forensic pathology, fingerprint and physical match testimony, where the expert gave his/her conclusions in the form on an opinion more reliable than DNA evidence where the conclusion was given in the form of a likelihood ratio. However, the expert witnesses (who gave their conclusion based on their opinion) used visual aids to demonstrate their conclusions. These experts spent more time educating the jury on the comparison process and how they came to their conclusions. The DNA experts explained briefly the science behind DNA but this may not have been enough for the jurors to fully understand the evidence type. Previous research has shown that visual aids used during the trial are extremely helpful to jurors (Brewer et al., 2004, Tindale et al., 2004, Hewson and Goodman-Delahunty, 2008, Blau et al., 2017).

This research also brought to light that as the education level of the juror increased their confidence in new technology decreased. These more educated jurors

reported having more confidence in traditional methods over new technology. The jurors with more education wanted the evidence explained to them and had a preference for understanding the evidence rather than simply trusting the testimony of the expert. They mentioned user error with new technology being their greatest concern.

Also revealed is that the jurors' perceptions of evidence reliability was linked to the expert witness's credibility. This correlation between reliability and credibility was moderate ($r\ (113) = .44,\ p < .001$) and indicates a moderate positive support for the hypothesis that witness credibility influences the jurors view of evidence reliability (hypothesis 1). Previous research suggested that jurors only base the reliability of the evidence on the expert witness credibility when the evidence is complex. The jurors in this study connected witness credibility with evidence reliability even when the evidence was simple, contrary to previous findings (Cooper et al., 1996, Devine, 2012).

Judges in the United States are responsible for permitting and denying expert witness testimony in court based on the reliability of the science behind the testimony. Depending on the jurisdiction, the judge is guided by a few landmark appellate cases that set forth guidelines for judging the reliability of the science and therefore expert witness admissibility (McAuliff and Groscup, 2009, Bernstein and Jackson, 2004, Bernstein, 2007). There is a general ground rule, that if a judge believes the expert

testimony meets some of the admissibility standards but the reliability cannot be conclusively determined, the judge may allow the expert to testify. In a recent paper Williams suggests that there are many reasons a judge may allow expert testimony that does not meet all of the admissibility standards. One of the reasons is an over reliance on the adversarial system (Williams and Saks, 2015).

The judge will allow the expert to testify and rely on cross examination to flush out the reliability of the evidence for the jury. This is of great concern given the results of this research. This research indicates that reliability of the evidence is based upon how the evidence fits with a story, its strength and most especially reliability is strongly linked to expert witness credibility. Judges, therefore, have an extremely important role in making sure the science the testimony is based upon is reliable, they cannot depend on cross examination to reveal unreliable evidence (Shellow, 2003, Dufraimont, 2008), or risk the jury basing reliability on facets of the testimony unrelated to the science (Givelber and Strickler, 2006).

6.4 Decision Making and Rendering Verdicts: How important is Forensic Evidence?

Forensic science evidence plays a part in many homicide trials and there is a perception in the legal field that jurors expect forensic testimony. This expectation is known as the C.S.I effect, after the popular T.V. show. This research revealed a

moderate support for a connection between watching crime shows and how jurors viewed forensic evidence presented at the trial. Two (10%) jurors reported that they felt the way science was portrayed on the crime shows was close to reality. This suggests that some jurors may have unrealistic expectations for forensic science evidence.

Jurors were asked which witnesses (expert witnesses, police witnesses or lay witnesses) had the most impact on their decision making. 78% of the jurors reported that the expert witnesses' testimony had a greater impact than the police or lay witnesses. When asked how important the forensic evidence was in their decision making, 36% of the jurors said that the forensic evidence was important to "a large extent" and 53% stated that the forensic evidence was important "to some extent". The literature supports the importance of forensic science testimony in jury decision making (Jonakait, 2003, Garrett and Neufeld, 2009) and other research has shown that in cases where there was forensic science evidence presented the defendants received longer sentences (Ryan et al., 1987, Winter and Robicheaux, 2011).

6.5 Jurors' Perceptions of the Attorneys

Overall the jurors described being satisfied with the trial attorneys. They reported the attorneys asked the questions they needed them to ask and elicited the necessary information from the expert witnesses. Some of the jurors suggested that the attorneys

introduce a time-line during the trial to aid the jurors with putting the events before, during, and after the crime into perspective. Jurors also suggested that closing arguments should be used to remind the jury of the important parts of the trial. Some jurors described their frustration when the attorney used their time during closing arguments to play to the jury rather than summarize the case for them. These suggestions from the jurors help to answer research question 3 and illustrate some of the factors which can cause difficulty with understanding the forensic science evidence and also highlight the importance of the evidence fitting within a narrative story.

Jurors viewed the attorneys in an unfavorable light when they perceived the questioning of the expert witnesses was demeaning and when the questioning was too repetitious. Previous research has shown that jurors' negative perceptions of defense attorneys can influence jury decision-making (Wood et al., 2011a).

Chapter 7: Summary and Recommendations for Further Research

7.1 Summary of Findings

Research Question 1 (RQ1) asked "How do jurors assimilate forensic science evidence into the other narrative information associated with the trial and how does this influence their decision making?" This research supports the theory that jurors process the information presented at the trial by actively trying to understand the evidence (central processing) or by taking mental shortcuts or heuristics (peripheral processing). Jurors in this study tended to engage in peripheral processing when they did not understand the evidence and in these circumstances based the value of the evidence on the credibility of the forensic scientist. Jurors who struggled to understand some of the forensic science evidence explained that the process of deliberation was helpful in evaluating the importance and value of the evidence.

The story model suggests that when evidence presented in court fits within a plausible story jurors will value this evidence when making decisions. When jurors struggle to understand how an item of evidence "fits" within a story they tend to value this evidence less. This research supports the story model of jury decision making and indicated that testimony, which did not fit with the story the juror had constructed about how the crime was committed, tended to be given less value.

Jurors in this study explained that they (for the most part) understood the forensic science testimony presented to them. When the testimony indicated a strong association or a strong non-association between the defendant and the victim or crime scene, jurors placed a lot of weight on the evidence. When the evidence presented had weaker associations or non-associations, jurors gave the evidence less value. This supports the theory that jury decision making will follow the strength of the evidence presented at the trial.

Research Question 2 (RQ2) asked "Do jurors correctly understand the testimony of the forensic scientist and do they place the appropriate weight on the evidence given the testimony?" This research indicated that when jurors truly understand the forensic science evidence they reported placing the appropriate weight on the testimony. Issues did arise when they did not fully understand the evidence. In these circumstances they relied on other jurors during the deliberation process or based the value of the importance of the evidence on the credibility of the witness.

Research Question 3 (RQ3) asked "What factors cause jurors difficulty with understanding the forensic science evidence?" During the interviews jurors were asked to describe the greatest challenges they experienced in evaluating the forensic science evidence. The jurors explained that trying to remember and put together all the details and information heard during the trial into the proper order and context was challenging. Jurors in Maine are only allowed to take notes during the trial, at the discretion of the judge. In 7 of the

9 trials jurors were not allowed to take notes. This put an unnecessary burden on the jurors during the deliberation process. The trials ranged from 1 week to 3 weeks in length. In their landmark publication, Kalven and Zeisel stated “the modern jury is asked to perform heroic feats of attention and recall well beyond the capacities of ordinary men” (Kalven et al., 1966). The jurors who were allowed to take notes described how these were helpful during the deliberation process and this is supported by a previous study (Rosenhan et al., 1994). Jurors without notes had to ask for portions of the trial transcript to be read back to them and they described this process as being inefficient and disjointed.

Judges may be worried that allowing jurors take notes may mean that the jurors do not pay full attention during the trial or that jurors who take notes may have more influence during the deliberation process. Previous research indicates that note taking during the trial was neither a distraction to other jurors nor did the jurors who took notes excessively influence the deliberation process (Heuer and Penrod, 1994, Heuer and Penrod, 1988, Horowitz and Bordens, 2002).

This research supports the hypothesis (hypothesis 1) that jurors view the training and experience of the forensic scientist to be more important in determining credibility than the certifications he/she has earned and if the laboratory he/she works in is accredited. When asked to rank attributes which might suggest credibility of a witness, the jurors overwhelmingly ranked

years of experience and university education higher than working in an accredited laboratory. Jurors indicated during the interviews that they understood what accreditation meant but felt it was less important than experience or education. Although certifications were ranked lower than experience or university education, jurors still thought certifications were important for the forensic scientist to hold.

Research Question 4 (RQ4) asked "What factors influence how jurors judge the credibility of forensic science experts and the reliability of forensic science evidence?" and hypothesis 2 (H2) suggested that the perceived reliability of evidence would be based on the juror's view of the credibility of the witness. Jurors judged the forensic scientist's credibility on their courtroom demeanor and how well they presented the evidence to the jury. The jurors in this study based the reliability of forensic science evidence on the chain of custody of the evidence and how closely the evidence fit within a story they had constructed of how the crime took place. Jurors also described evidence which connected the defendant to the victim or the crime scene as reliable evidence.

There is moderate support for hypothesis 2 (Pearson's correlation coefficient of +0.44, N=29, P= .01) which stated that the juror's view of the reliability of the evidence is based in part upon the perceived credibility of the witness.

A parallel convergent exploratory mixed methods design was used to approach these research questions and hypotheses. The quantitative results were supported by the qualitative data from the interviews. The open ended interview questions allowed jurors describe in their own words their perceptions and experiences of the forensic science evidence and gave a depth of understanding to the juror's experiences and perceptions.

7.2 Recommended Procedural and Policy Changes

7.2.1 Before the Trial

A lot can be done to bring juries up to speed with the scientific evidence presented at a trial. It has been suggested that more should be done to educate juries as part of the empaneling process (Strier, 1997). This was also a suggestion by some of the jurors in the study. Juries could be educated by watching video presentations as is done when explaining the rights of defendants during the arraignment process. Other researchers have suggested handbooks for jurors on court procedure and scientific testimony (Johnson, 1948). Judges have researchers available and the assistance of law clerks to help them interpret and understand complex scientific testimony. The jurors do not have access to these resources (Hans, 2007) and for this reason it is recommended that the jury be given some basic level of education or primers on complex scientific matters prior to the trial. Other jury researchers have suggested that blue collar juries made up only of educated jurors be reinstated in order to address jury understanding of the evidence (Hans et al., 2011). However the current jury system, of selecting jurors with a wide range of educational background and cognitive abilities, could be improved by

giving jurors additional education before and during the trial.

7.2.2 During the Trial

The judge as the gatekeeper has a difficult and important role in making sure only reliable scientific evidence is introduced during the trial. The judge should not rely solely on his/her instructions to the jury, on the process of cross examination or the use of other experts to explain or attempt to mitigate testimony that may not be scientifically robust, as this has been shown to ineffective (Eastwood and Caldwell, 2015). More must be done by the gate keeper prior to allowing an expert witness to testify in order to make sure only reliable evidence is presented. In this regard the availability of judicial primers explaining the science in simple terms to the judge so that a decision of evidential admissibility can be made would be advantageous.

Expert witnesses should make sure that they take the time to properly qualify themselves as an expert prior to testifying about the evidence. Expert witness credibility had been shown in this study to be linked to how reliable the jurors perceive the evidence to be. When testifying about the evidence the expert must be aware that the jurors need to hear much more than the expert's conclusions in order to place value and weight on the evidence (Schweitzer, 2016). Jurors have an expectation that the expert will teach them about the process they went through in coming to a conclusion.

Visual aids are an important component in assisting with understanding the evidence. Recent research (Blau et al., 2017) supports the finding of this study that visual aids are an important tool to aid juror understanding of forensic science testimony. Expert witnesses should make use of court room technology and take the time to educate the jurors as far as possible so that they can understand and place value on the evidence presented.

It is permissible under Maine law for jurors to take notes during the trial. The decision to allow the jurors to take notes is by judicial discretion. It is recommended that jurors be allowed to take notes as the benefits outweigh the risks. It is anticipated that allowing jurors to take notes would reduce juror stress, especially in complex cases and may lead to more accurate decision making.

7.3 Recommendations for Future Research

This research has exposed some of the weaknesses in juror decision making in regards to understanding expert witness testimony. The methodology of the study worked well and the research should be repeated elsewhere.

The study examined the juror responses to testimony given by state experts and future research should examine if responses would be similar if defense experts were the focus of the study. If future research is carried out it should attempt to make the

sample size larger. A larger sample size could reaffirm the conclusions in this study or could highlight differences due to the sample size. Other research of interest would be to examine juror responses in non-homicide trials and in cases where the defendant was acquitted.

Finally, it would also be worth investigating how the jurors would value the evidence presented by experts who were in the early stages of their career. Apart from one expert who had 7.5 years' experience all others had 13 or more years of experience. The jurors indicated overwhelmingly that experience, on average, was the number one trait they used to evaluate the credibility of the expert witness, and it would be helpful to the forensic science community to understand how jurors would rate credibility in examiners in the first few years on the job.

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Appendices

Appendix 1: Judicial Order

STATE OF MAINE SUPERIOR COURT

ORDER FOR RELEASE OF TRAVERSE JUROR INFORMATION

WHEREAS, pursuant to 14 M.R.S. §1254-B(3), RESEARCHER WILCOX, a PhD. candidate at the Husson University College of Business, School of Legal Studies, has submitted a request for an Order for the limited disclosure of the names of traverse jurors who have served on criminal jury panels and whose period of juror service has expired;

WHEREAS, the request is for the period from June 1, 2014 to May 31, 2015, ("Authorized Period") and is supported by an affidavit stating the basis for the request, and

WHEREAS, the Court finds that such limited disclosure meets the requirements of 14 M.R.S. § 1254-B (3) and is in the interests of justice.

NOW, THERFORE, it is ORDERED, that the request is GRANTED, and

RESEARCHER WILCOX is authorized to receive through the office of the Chief Justice of the Maine Superior Court the names and addresses of traverse jurors who have served on criminal jury panels and whose period of juror service has expired ("Juror Information"), as follows:

1. During the Authorized Period, RESEARCHER WILCOX may from time-to-time receive Juror Information in criminal cases identified by her in a written request to the Office of the Chief Justice of the Superior Court.

2. The Juror Information may only be used to send to such jurors a questionnaire identical to that appended as Exhibit A to her affidavit in support of her request underlying this Order. A copy of the affidavit is annexed to this order and incorporated herein by reference.

3. RESEARCHER WILCOX, and her agents and representatives, shall maintain the confidentiality of the Juror Information and use it only for the purposes for which it was requested and released, and may not further disseminate or disclose such juror information except as hereby authorized.

This Order is ongoing and shall remain in effect during the Authorized Period unless or until withdrawn, revoked or amended by the Chief Justice of the Superior Court.

Date: May_____, 2015

_____

Thomas E. Humphrey, Chief Justice, Maine Superior Court

Appendix 2: Overview of the Nine Trials

Trial A

Background

This case consisted of a homicide of female whose body was found in a vehicle a few months after her death. Due to very cold winter conditions her body was very well preserved facilitating the viability of DNA evidence. It was reported that the cause of death was due to a fatal gunshot wound. DNA evidence was collected from her clothing and from a sex crimes kit used in the examination of the body. The evidence in the case was complicated by the fact that the apartment where the victim had lived was undergoing remodeling when the investigation began. Walls and floors had been removed. A bullet had been found a wall stud and it was concealed with chewing gum. The defendant and victim knew each other. The defendant's DNA was identified on semen samples found on the victim as well as on the chewing gum recovered from the victim's apartment. Blood stain pattern analysis confirmed that the apartment was the likely location of the fatal shooting. Two expert witnesses (forensic chemist and a DNA expert) provided evidence in the case and an overview of the evidence is presented in Figure 35. The ballistic expert was not observed in this trial.

Overview of the Expert Witnesses' Testimony

1) The forensic chemist reported having 16 years of experience. The expert testified about the swabs from the sex crimes kit and cuttings from the victim's clothing. The expert discussed Prostate Specific Antigen (PSA) testing, a confirmation for the presence of semen. The forensic chemist testified that the presence of human blood was confirmed in the basement of the apartment and in stains on a door in the apartment. The witness was extremely clear and came across in a professional manner and was easy to listen to. This witness took the time to explain to the jury how presumptive tests and confirmatory tests were carried out. The expert used common comparisons to everyday items to explain the processes, for example, when describing a confirmatory test for semen the examiner likened it to a pregnancy test. Cross examination of this witness was weak and the defense attorney repeated questions that the prosecution had asked.

2) The DNA examiner reported having 19 years' experience. The expert provided a clear explanation of nuclear DNA and Y-STR testing. The expert explained inclusion probabilities for mixture DNA samples, although the explanation may not have been understood by the majority of jurors. Overall, while the testimony was in layman's terms, the explanations were very brief and more time may have been needed to help the jurors grasp how DNA analysis was carried out and how conclusions are arrived at. The witness appeared to be very at ease testifying in front of a jury.

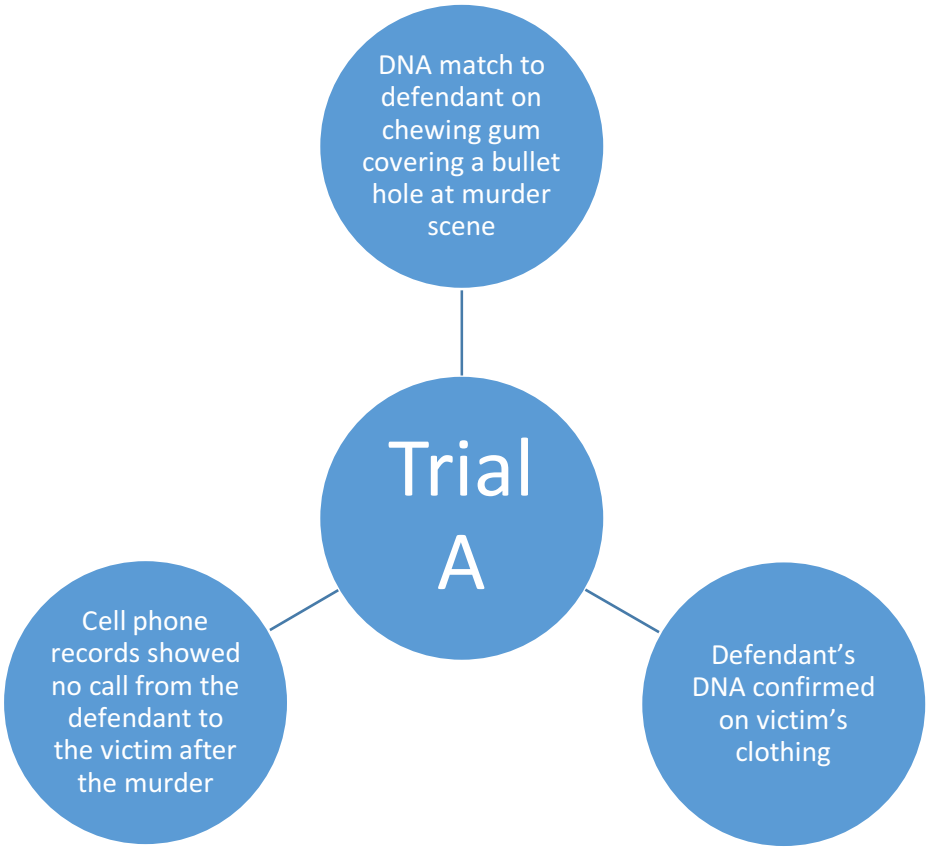

Figure 35: **Schematic overview of Trial A**

Trial B

Background

This case involved the murder of a female under the age of 18. The girl was reported missing and her body was found in a wooded area a few days later. Triangulation of cell phone towers and cadaver canines assisted in locating her body. Triangulation of cell phone towers and cadaver dogs assisted in locating her body. Some of the victim's clothes were found in a different location from her body. The victim and the defendant were acquaintances. Four experts (fingerprint examiner, medical examiner, forensic chemist and DNA expert) provided testimony and a schematic of the evidence is presented in Figure 36.

Overview of the Expert Witnesses' Testimony

1) The forensic latent print examiner reported having 13 years' experience. This expert witness took a lot of time explaining their education and training to the jury and they sounded very experienced. The expert described the science of fingerprints and why fingerprints in general can be compared and conclusions drawn. The expert explained how fingerprints develop in the womb and why fingerprints are not found on all surfaces that are touched. The witness testified to identifying a fingerprint on a note to the defendant. The witness used a PowerPoint presentation to illustrate the comparison between the questioned fingerprint and defendant's known impression. The defense attorney asked challenging questions during cross examination and the examiner was able to answer these easily and this made the examiner sound more credible.

2) The medical examiner described her education and qualifications and reported having performed over 4000 autopsies. The medical examiner testified to the examination of the victim's "young" body and reminded those at the trial of the humanity of the victim. Jurors were watching the victim's mother cry when the medical examiner testified. It was estimated that by the time the body had been found the victim had been dead for a period of time that was estimated between 48 hours and a few weeks.

3) The forensic chemist testified as a trace evidence examiner. The qualifying questions very short, as the prosecuting attorney only asked the expert a few questions about

her background. This was in sharp contrast to the medical examiner and latent print examiner. This expert testified to presumptive tests for seminal fluid and to fabric damage on items of clothing. The examiner described examining hairs under the microscope and appeared comfortable in front of the jury. The defense attorney during cross examination asked a few questions that were comical or did not make sense. In answering these questions the expert's answers were short and not as forthcoming as they were during direct examination.

4) The DNA examiner reported having 21 years' experience. The expert described the science of DNA to the jurors and their presentation of their evidence was confident. The examiner explained how DNA came from the biological parents and how forensic DNA analysis compares 13 distinct markers across the various samples examined. The defense attorney appeared argumentative during cross examination but the DNA expert witness was very calm.

Figure 36: Schematic overview of Trial B

Trial C

Background

The case involved a male family member allegedly murdering a female family member and then setting fire to the body and the crime scene. There were four expert witnesses (a tool mark examiner, a fire debris analyst, a DNA examiner and a fingerprint examiner) and a schematic of the case is presented in Figure 37.

Overview of the Expert Witnesses' Testimony

1) The tool mark examiner testified to having had 16 years' experience as a forensic scientist. The expert testified to the comparison of various tools to injuries on the victim's skull. The expert was very comfortable in front of the jury and the jury seemed engaged during this testimony. The expert explained that test impressions of the tools were made. Using photographs as a visual aid the expert demonstrated to the jury why one of the tool could have been the source of the skull fracture.

2) The fire debris examiner reported being retired from the crime laboratory but having 17 years' experience. The expert described how the fire debris samples were analyzed and that accelerants were confirmed at the crime scene. This witness was calm and came across very professionally during direct and cross examination.

3) The DNA examiner reported having 19 years' experience. The expert clearly explained nuclear DNA and how DNA comparisons are carried out. The expert was able to confirm DNA of the victim in blood recovered from the suspect's shoe.

4) The forensic latent print examiner reported having 14 years' experience. The expert described the science of fingerprints and why they can be used in forensic science. The expert explained how fingerprints develop in the womb and why fingerprint are not found on all surfaces that are touched. The expert reported not finding any fingerprints

of the defendant on evidence items related to the homicide.

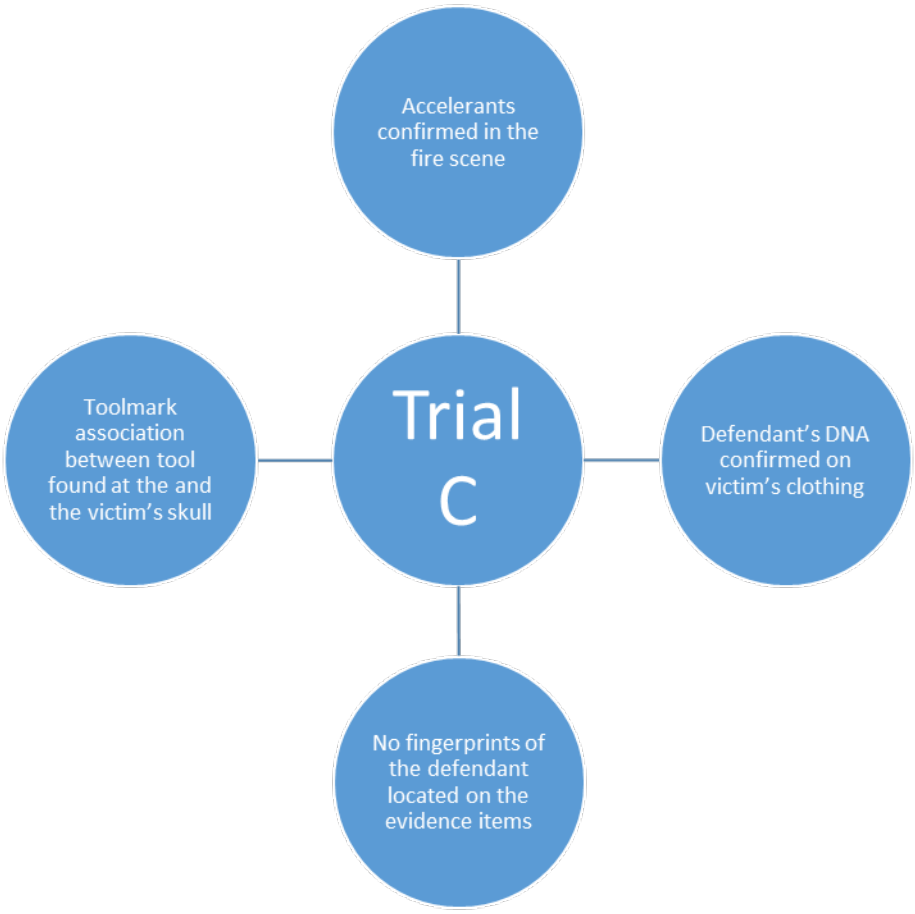

Figure 37: **Schematic overview of Trial C**

Trials D and E:

Background

This case involved the murder of a male victim by two of his male friends. The victim was beaten and strangled and his body was disposed of at the bottom of a stream. There were two defendants who were tried separately but the trials were very

similar and the same experts testified in both. The trials are presented together for the purposes of this description. In total three experts provided evidence (an Impression examiner, a Forensic Chemist and a DNA expert) and a schematic of the case is presented in Figure 38.

Overview of the Expert Witnesses' Testimony

1) The forensic impression examiner reported having 13 years' experience. Tire impressions were found at the crime scene. The quality of impressions were low due to the substrate they were in being gravel. The examiner testified to tire impression examinations and that the tires on the suspect vehicle could not be eliminated from impressions casted at the scene. The testimony also included physical match examination of garbage bags and bed sheets. A partial bed sheet was found with the victim and another part found with the defendants. A garbage bag found with the victim was compared to the roll of garbage bags found with the defendants. Extensive testimony of how garbage bags are made was given and included explaining how garbage bags are manufactured. Both videos and PowerPoint presentations were used to assist the jurors with understanding the evidence. The expert testified that the garbage bag found with the victim came from the same roll as was in the defendants' home.

2) The forensic chemist reported having 15 years' experience. This examiner testified to searching for hairs and fibers as well as serology evidence, such as blood. The expert explained to the jury what presumptive and confirmatory tests were and how they were carried out. The expert explained some of the false positive reactions that could happen. This examiner took multiple swabs of red/brown stains and sent them to the DNA section for testing.

During cross examination the defense attorney asked questions about a report that criticized some of the forensic science disciplines (this was the National Academy of Science report of Strengthening Forensic Science in the US) (National Research Council, 2009). The expert told the court that he was aware of the report but had not read it in its entirety. The defense questioned the expert's credentials and after a side bar the expert was asked additional qualifying questions. Throughout the lengthy cross examination the expert was relaxed, answered the questions fully and maintained a lot of eye contact with the jury.

3) The DNA Examiner reported having 17 years' experience. The examiner testified to testing multiple swabs and cuttings from fabric items for human DNA. Most items were HemaTrace negative, meaning that human blood could not be confirmed. This expert was not cross examined by the defense attorney in one case but was more extensively cross examined in the second trial.

Figure 38: Schematic overview of Trials D and E

Trial F

Background

This homicide was a case of domestic violence where a man stabbed his intimate partner to death with a knife. The defendant claimed that he was defending himself against the victim. Three experts provided evidence (a forensic chemist, a DNA examiner and a fingerprint examiner) and a schematic of the case is presented in Figure 39.

Overview of the Expert Witnesses' Testimony

1) The forensic chemist reported having 15 years' experience. The expert made a lot of eye contact with the jury and was very engaging. The expert appeared very relaxed during the testimony and came across as a very likable person. The expert testified to examining knives for the presence of blood. This expert was not cross examined by the defense.

2) The DNA examiner reported having 15 years' experience. The expert explained the history of DNA and how it came to be used in criminal cases. The jurors appears to give the expert their full attention. The expert explained how mixtures of DNA profiles result in different statistical conclusions from single source DNA samples. The expert was cross- examined by the defense but was only asked a few straight forward questions. The expert identified the defendant's blood on numerous items that were swabbed in the house they shared.

3) The latent print examiner reported having 15 years' experience. The expert testified to a wide range of training, courses and certifications which made this expert appear very credible. The expert explained latent and invisible fingerprints and fingerprints from known sources. The expert testified that the defendant's fingerprint was confirmed on the blade of one of the knives.

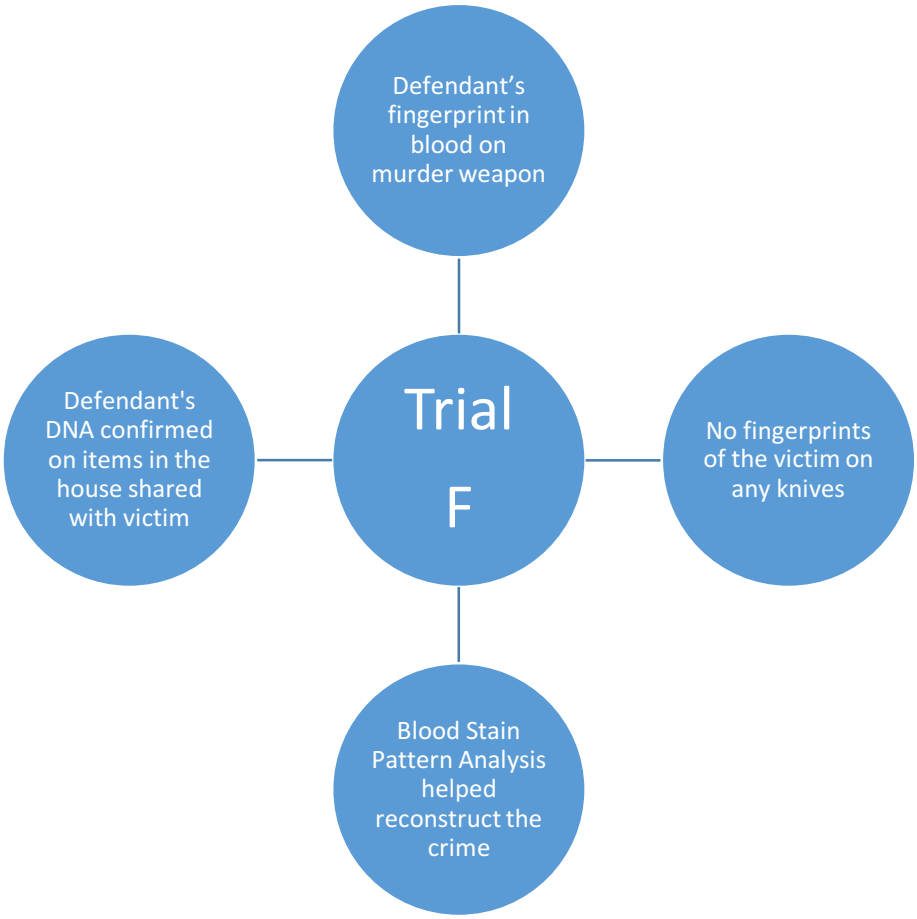

Figure 39: **Schematic overview of Trial F**

Trial G

Background

This case involved the murder of a man in his home by an acquaintance. The defendant was linked to the murder through DNA. The motive was reported to be robbery where the defendant was trying to support a drug habit. Money and items of jewelry were stolen. The jewelry later was located at a pawn shop. Two experts provided evidence in the case (a DNA examiner and a medical expert) and a schematic of the case is presented in Figure 40.

Overview of the Expert witnesses' testimony

1) The DNA examiner reported having 14 years' experience. The expert testified to receiving cuttings and swabs to analyze for DNA. The defendant's DNA was confirmed in areas of the home where the victim kept money.

2) The medical examiner testified that the cause of death was multiple stab wounds.

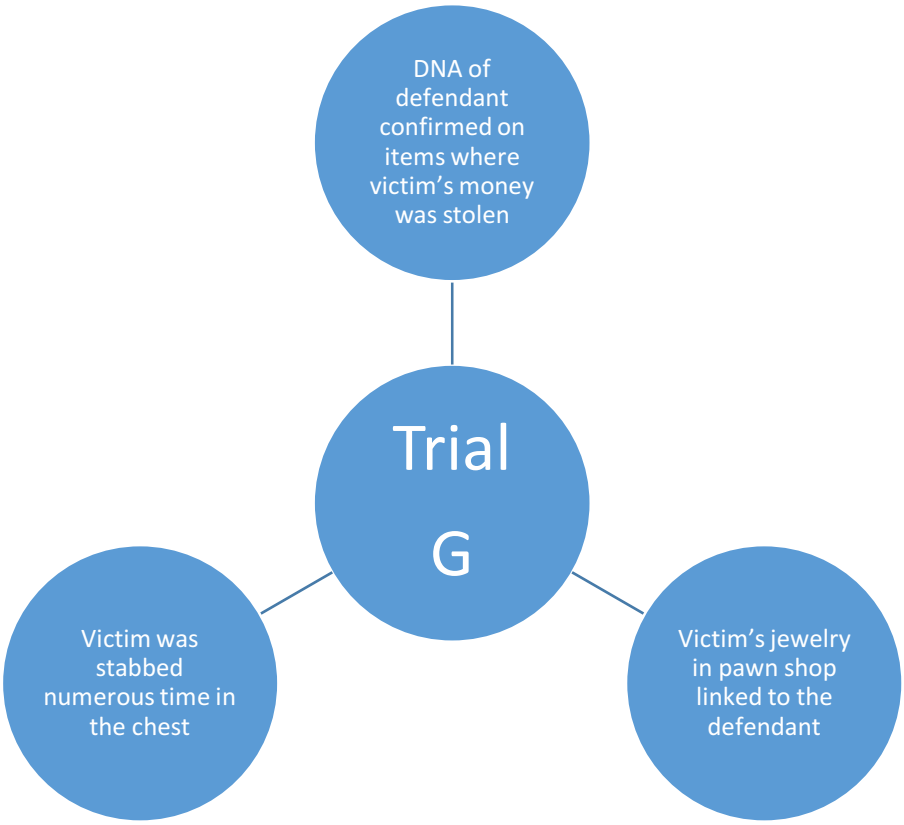

Figure 40: **Schematic overview of Trial G**

Trial H

Background

This case involved the murder of multiple victims. Their bodies were found in a burned out car. The defendant attempted to cover up the crime by burning the bodies. Three experts provided evidence for the prosecution (two fire investigators and one fire debris analyst) and a schematic of the case is presented in Figure 41.

Overview of the Expert Witnesses' Testimony

1) The Fire Marshall reported having 7.5 years' experience. The expert described having received extensive training on origins and causes of fires and explosions. This expert testified to the methods of preserving and collecting evidence from the scene. The expert described the difficulty in locating evidence related to the homicide due to fire damage and water that was sprayed on the scene by the fire department.

2) The Fire Marshall reported having 31 years' experience. This expert explained the numerous training courses and certifications that were acquired through the course of his career. The expert testified to the science of how fires burn, fuels and origins and causes of fires. The expert discussed radial burn patterns and explained how the burn patterns can help pin point the area of origin of the fire. The fire debris samples were screened by an accelerant detection canine. This expert explained how the canines do their job and how they undergo regular testing based on national standards. The expert

was responsible for evidence packaging at the scene. A melted blue (possible kerosene) container was a major piece of evidence discussed.

3) The fire debris expert reported having 12 years' experience. The qualifying questions related to the expert's credentials were short but the expert described at length how fire debris samples are processed in the laboratory. The expert's testimony was thorough and was delivered in such a way that the jury could understand it. The expert explained techniques that were involved when heavy petroleum products, such as kerosene, were detected.

Figure 41: Schematic overview of Trial H

Trial I

Background

This crime involved the stabbing to death of one man in his home by the defendant who was an acquaintance. The prosecution suggested that the motive was drug related. The defense team suggested that the murder was in self-defense. Four experts provided evidence in the trial (a tool mark examiner, a forensic chemist, a DNA expert and a bloodstain pattern examiner) and Figure 42 is a schematic overview of the case.

Overview of the Expert Witnesses' Testimony

1) A forensic tool mark examiner with 6 years' experience testified to tool mark comparisons from various tools to multiple substrates. The comparison process was clearly described to the jury. The tool mark examiner used a PowerPoint presentation to illustrate the tool mark comparison. The testimony indicated that there was an association between the tool and marks found at the crime scene. The tool mark examiner could not say definitively if the tool had made the marks. The examiner also performed comparisons between a footwear impression found at the crime scene and the defendant's shoes. The examiner testified that the crime scene impression and the defendant's shoes had the same outsole pattern.

2) A forensic chemist specializing in blood stain pattern analysis with 16 years' experience

testified to the range of blood stains located at the crime scene. The testimony the expert showed a depth of knowledge and the expert was confident explaining the science to the jury. The examiner's testimony explained blood stain patterns in different parts of the home and in the area where the victim was found.

3) A forensic DNA examiner with 14 years' experience described her extensive qualifications. The testimony was flat and the expert gave the impression that appearing in court was bothersome. The DNA examiner testified to the sources of DNA profiles collected at the scene. The DNA testimony was relatively simple and easy to understand.

4) A bloodstain pattern examiner with 7 years' experience, described his qualifications and the process of peer review in blood stain pattern analysis. The examiner attended the crime scene and analyzed the blood stains there and collected some stains for DNA analysis. The examiner testified that he had observed cast-off blood stains and the types of weapons that could be associated with these types of patterns.

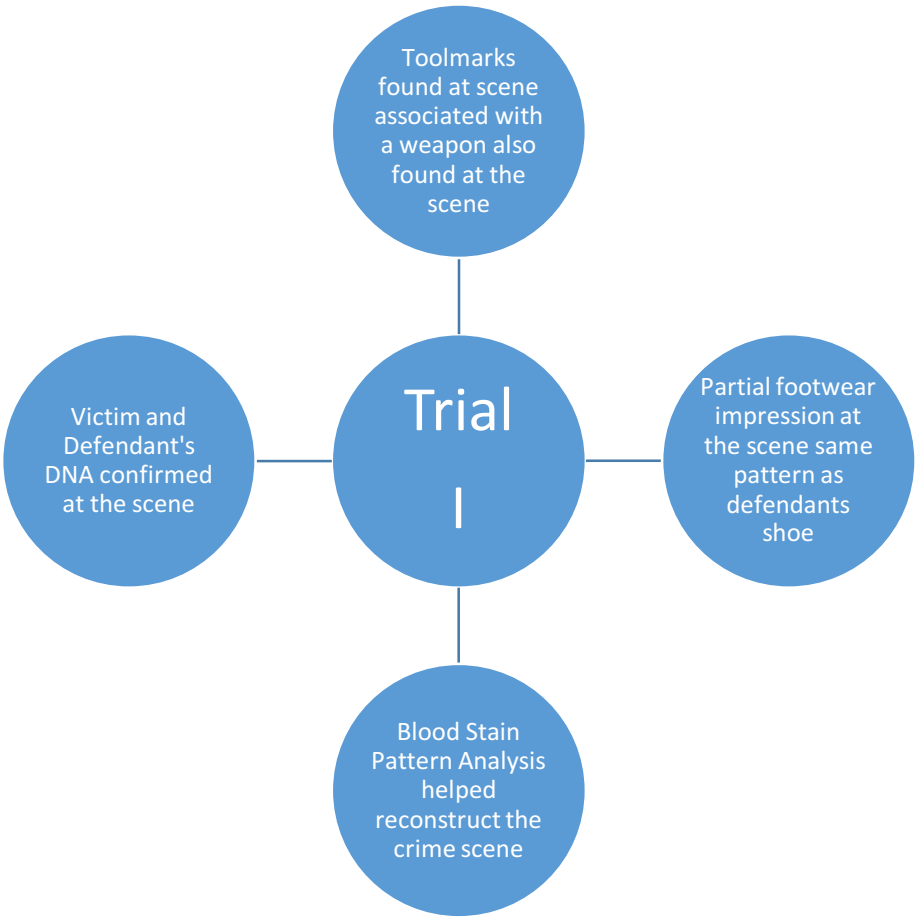

Figure 42: Schematic overview of Trial I

Appendix 3: Demographics and Jury Composition

Gender

In 2015 the Maine population consisted of 49% males and 51% females (Figure 41). During the period of this research there were 10 homicide trials where forensic science expert evidence was presented. Out of the 10 trials, 156 surveys were mailed and 29 (18.5%) completed surveys were returned. These surveys covered 9 homicide cases heard in Maine from July 2014 to April 2016 with responses ranging from 1 to 5 per trial. Of these 29 jurors, 22 (76%) participated in follow up phone interviews. Figure 42 illustrates the gender distribution of all 156 jurors and alternate jurors who were sworn in and observed the expert testimony. Females made up 46% of the jurors and males 54%.

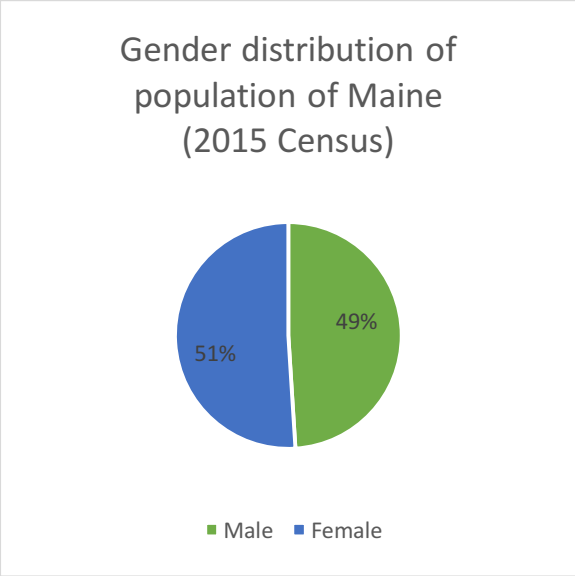

Figure 43: Gender distribution in the State of Maine

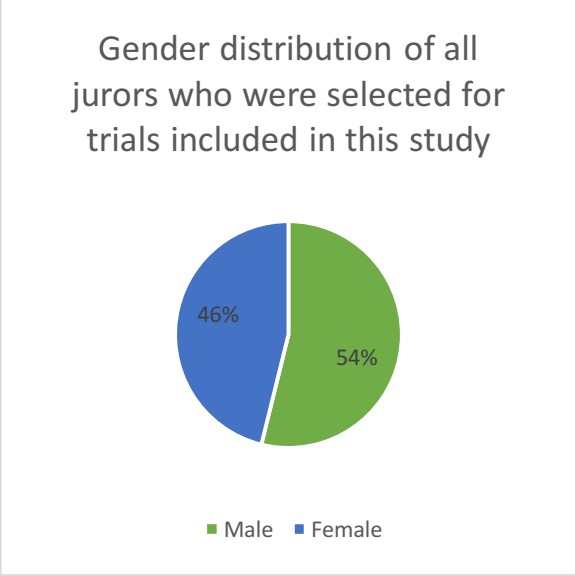

Figure 44: Gender distribution of the juries

The paper survey respondents in this study were made up of 13 women and 16 men giving an overall gender distribution of 45% female and 55% male (Figure 43). Of the 29 jurors who responded to the paper survey 20 participated in follow up phone interviews. This group was made up of 10 men and 10 women (Figure 44).

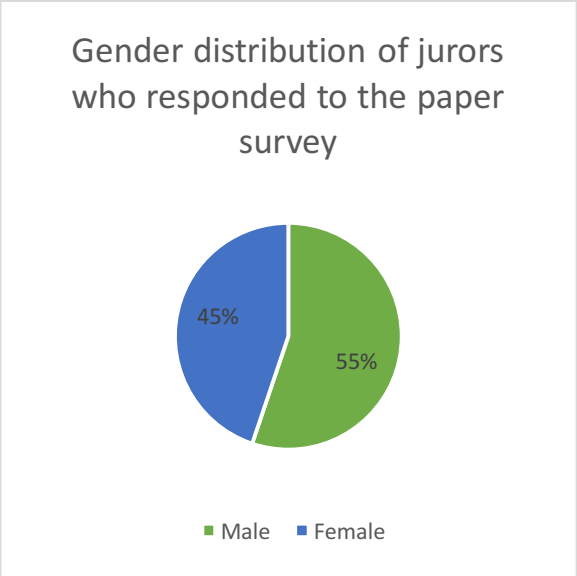

Figure 45: Gender distribution of those who responded to the survey

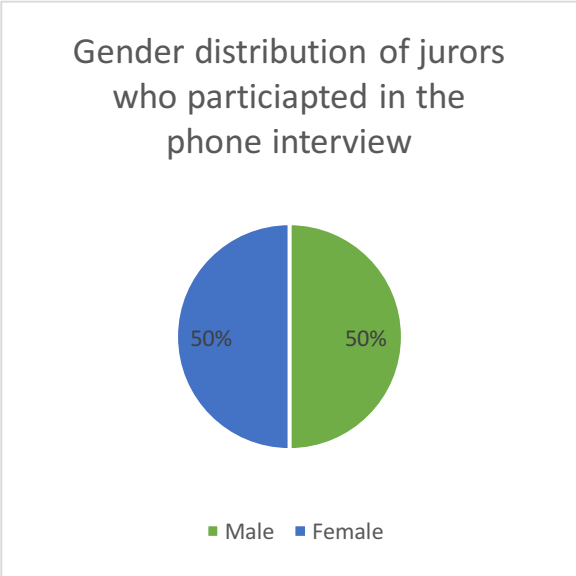

Figure 46: Gender distribution of those who were interviewed

The overall gender distribution of the survey and phone interview populations are consistent with the general gender distribution of all jurors (participant and non-participants in this research) and with the gender population in the State of Maine.

Age

The jurors who responded to the survey ranged in age groups from 18 to 65+. The sample is evenly weighted between the age groups 25-64 but is more heavily weighted in the over 65 group which accounted for 32% of the sample (Table 15 and Figure 45).

Table 13: Age distribution of the jurors

Age	Paper Survey		Phone Interviews	
18-24	1	(3%)	1	(6%)
25-34	4	(14%)	3	(19%)
35-44	5	(17%)	4	(25%)
45-54	5	(17%)	3	(19%)
55-64	6	(21%)	4	(25%)
65+	8	(28%)	5	(31%)

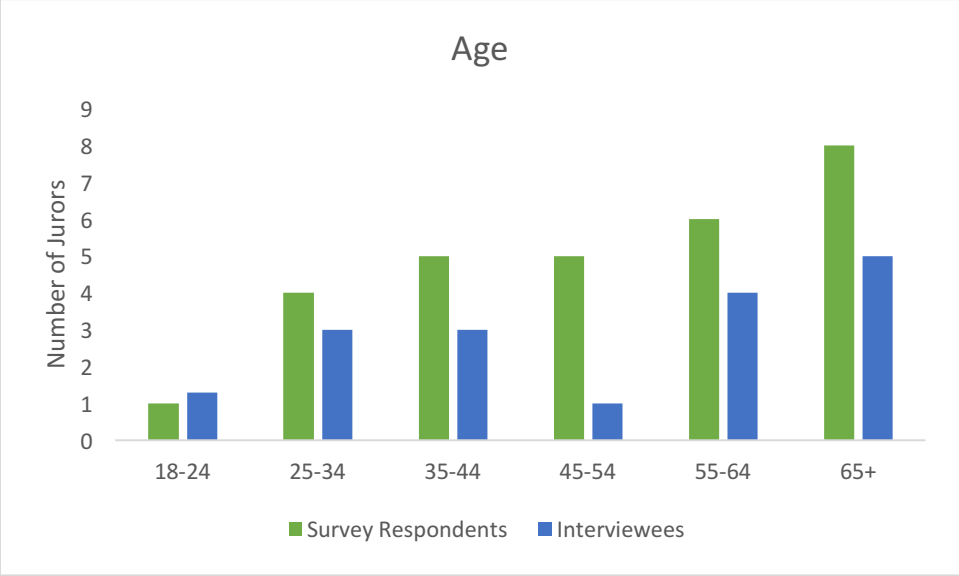

Figure 47: Age distribution of the jurors

Marital Status

Of the jurors who responded to the survey, 86% reported being married, in common law partnerships, civil partnerships or cohabiting (Table 16 and Figure 48).

Table 14: Marital Status of the Jurors

Marital Status	Paper Survey		Phone Interview	
Married	25	(86%)	19	(86%)
Divorced or Separated	1	(3%)	1	(5%)
Single, never married	2	(7%)	2	(9%)
Widowed	1	(5%)	0	(0%)

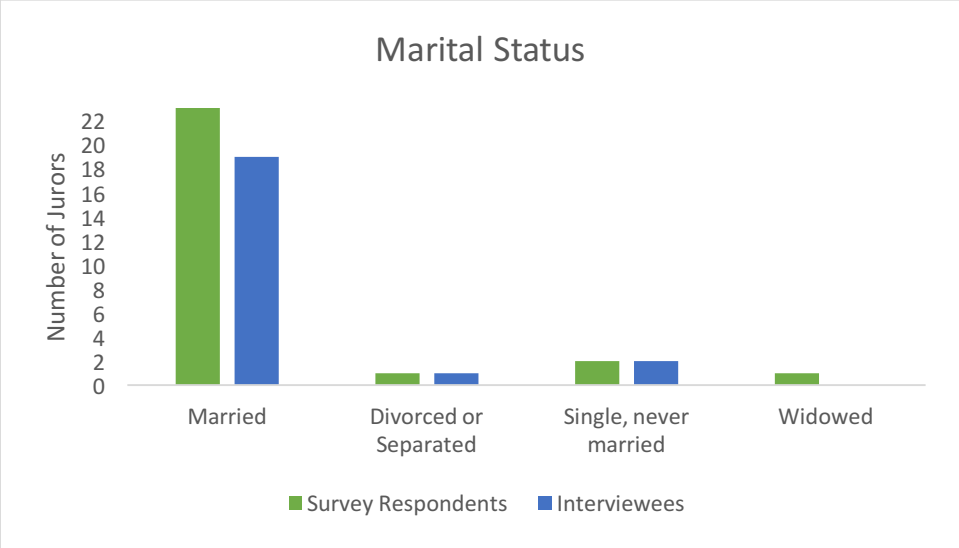

Figure 48: Marital Status of the jurors

Education

Jurors who participated in the research reported education levels ranging from high school to master degrees, with 52% holding a four year undergraduate degree or higher (Table 17 and Figure 47). One of the jurors mentioned during her interview that she was in the process of getting her doctorate.

Table 15: Education Level of the Jurors

Educational Level	Paper Survey		Phone Interview	
High School/GED	6	(21%)	5	(23%)
Some College	3	(10%)	2	(9%)
Two Year Degree	5	(17%)	1	(5%)
Four Year Degree	8	(28%)	8	(36%)
Master's Degree	7	(24%)	6	(27%)

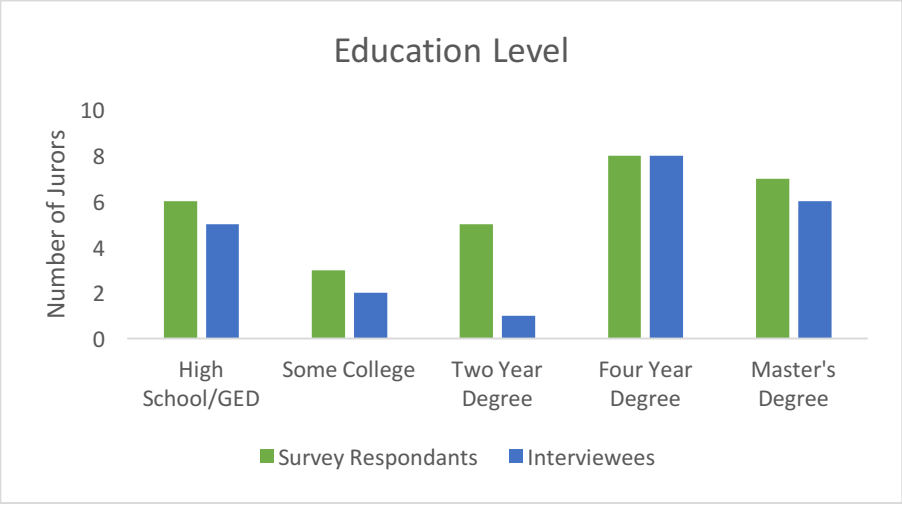

Figure 49: Education level of the jurors

Phone interviewees (16 jurors answered this question) were asked about their highest level of science and how long ago that had been, Figure 49 illustrates this distribution. The average previous engagement in science had been 23 years prior to the case. Figure 20 illustrates the breakdown of the highest level of science education. 60% of jurors had at least one science class at the undergraduate level, 20% of jurors had not taken any science class since high school and 20% of jurors had taken graduate science classes. Most of the science classes which jurors reported taking were required as part of a non-science program, however six jurors stated that their undergraduate or graduate degree was in microbiology, statistics, engineering or physics.

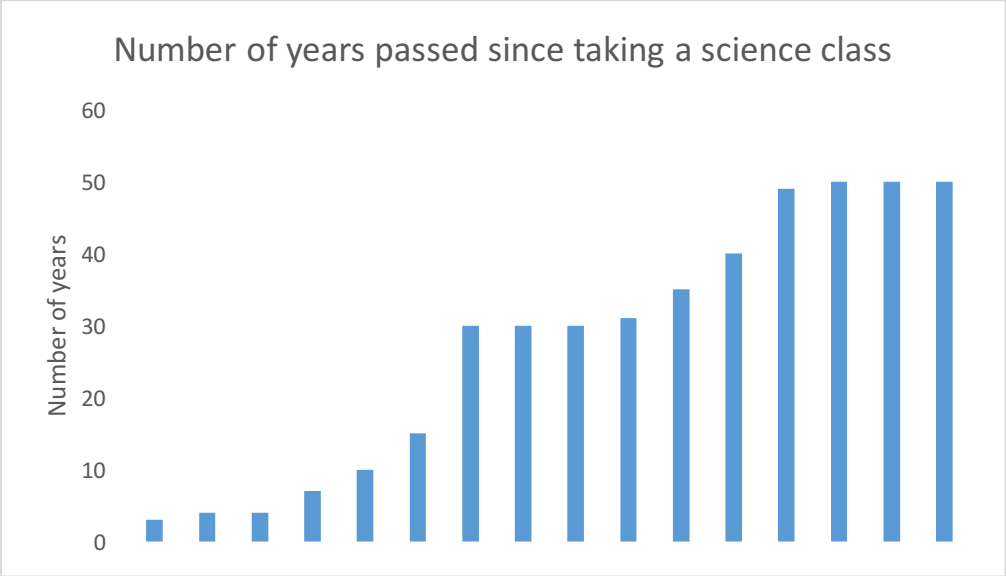

Figure 50: Distribution of time since jurors took their last science class

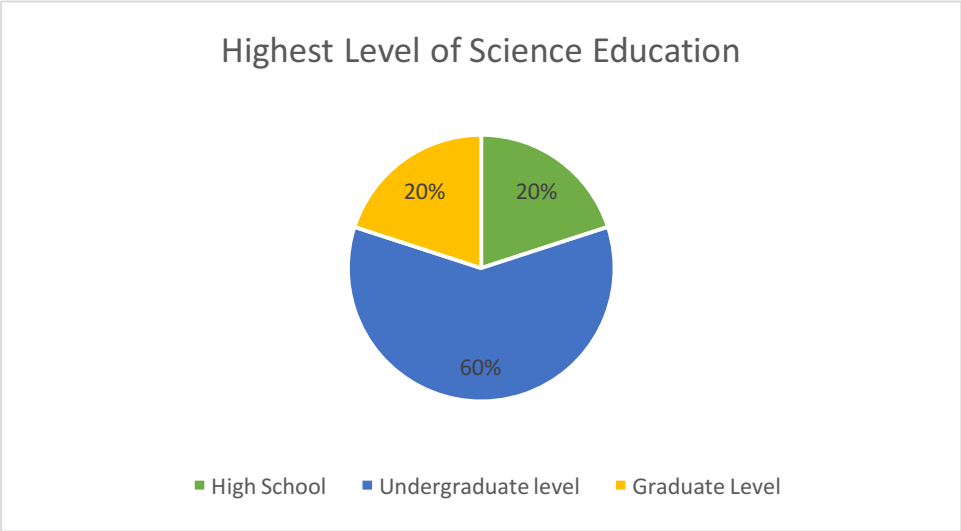

Figure 51: Highest level of science education received

Employment

Approximately two thirds (68%) of those who responded reported being engaged in full-time employment and 27% were retired, Table 18 and Figure 50 illustrates this. Phone interviewees were not asked specifically what industry they were employed in but many offered this information. Three jurors reported working in the medical field, two said they were engineers, one reported being a teacher, one juror said he was a microbiologist and one juror described her job as an optical specialist who sold eyeglasses.

Table 16: **Employment Status of the Jurors**

Employment Status	Paper Survey		Phone Interview	
Working Full-Time	19	(66%)	15	(68%)
Working Part-Time	1	(3%)	1	(5%)
Retired	9	(31%)	6	(27%)

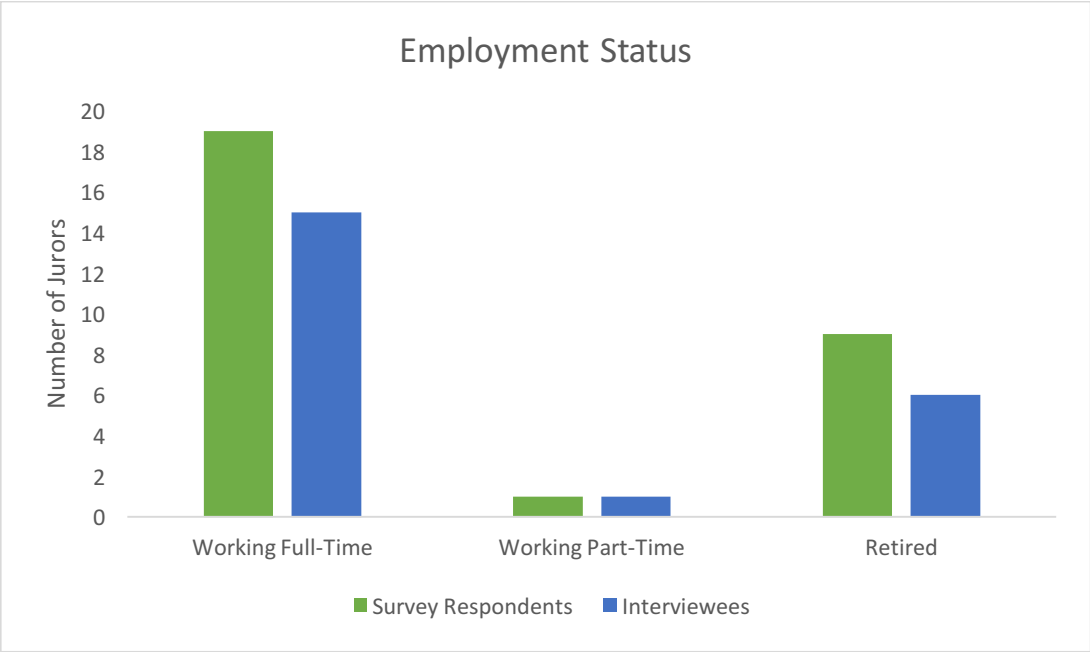

Figure 52: Employment Status of the jurors

Political Affiliation

Jurors were asked to choose from 9 different categories to describe their political ideology or affiliation (Table 19 and Figure 51). The major group, 24%, identified their political affiliation as being Moderate Conservative. Taking the three middle categories, Independent Leaning Liberal, Independent and Independent Leaning conservative accounted for 41% of respondents.

Table 17: Political Affiliation of the Jurors

Political Ideology / Affiliation	Paper Survey		Phone Interview	
Strong Liberal	4	(14%)	2	(9%)
Moderate Liberal	4	(14%)	4	(18%)
Independent Leaning Liberal	2	(7%)	2	(9%)
Independent	5	(17%)	3	(14%)
Independent Leaning Conservative	5	(17%)	4	(18%)
Moderate Conservative	7	(24%)	6	(27%)
Strong Conservative	2	(7%)	1	(5%)

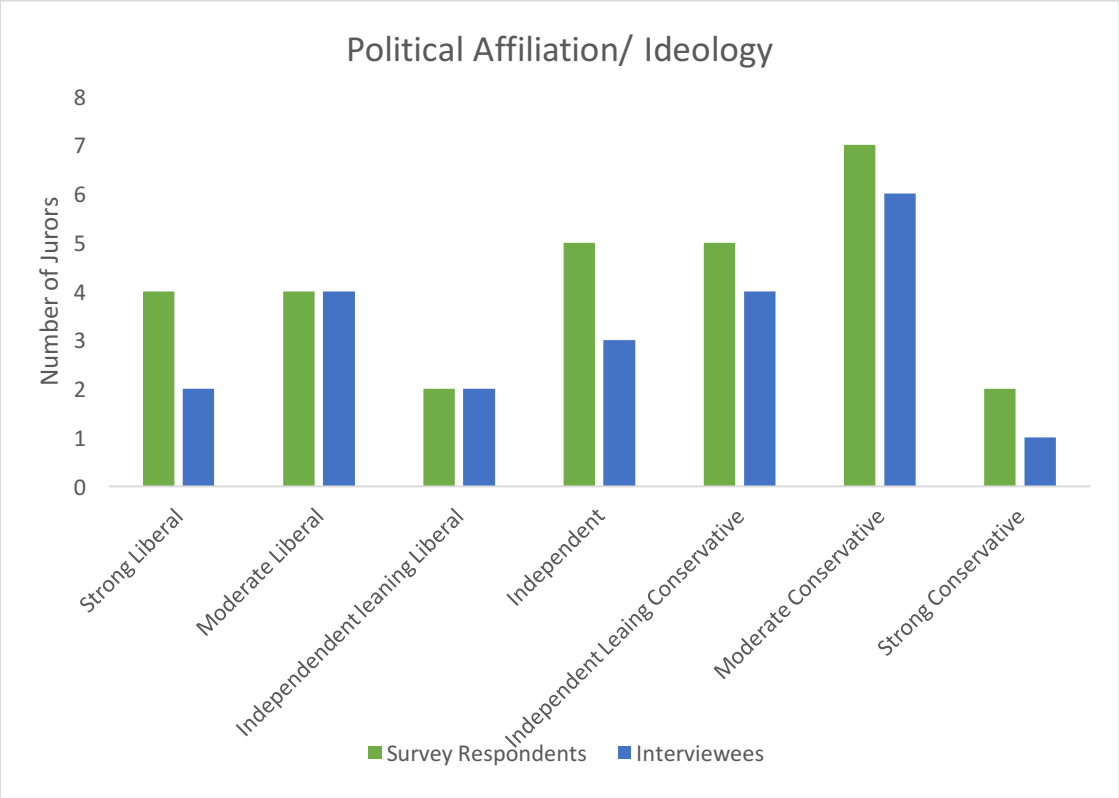

Figure 53: Political Affiliation of the Jurors

Appendix 4: Paper Survey

Research Survey

Please answer the following questions about yourself and the trial where you were a juror or alternate.

1. What is your gender?

   - Male
   - Female

2. What is your Marital Status?

   a. Single, never married
   b. Married (including common law, civil partnership and cohabiting couples)
   c. Widowed
   d. Divorced or separated

3. How old are you?

   - 18-24
   - 25-34
   - 35-44
   - 45-54
   - 55-64
   - 65+

4. What is the highest level of education you have completed?

   - Less than high school
   - High school/ GED
   - Some college
   - Two year college degree (Associate)
   - Four year college (BS or BA)
   - Master's degree
   - Doctoral degree

5. What is your Occupation?

- Working full time (more than 30 hours a week)
- Working part-time (8-30 hours a week)
- Homemaker (full time)
- Student (full-time)
- Temporarily unemployed (but actively seeking work)
- Retired
- Other permanently unemployed (e.g. chronically sick, disabled, independent means)
- Other_____

6. How do you keep up with current events and the news? Check the all that apply

- Do not keep up with current events/ news
- Newspapers
- Online news sources
- TV News Shows
- Radio
- Other, Please specify_____

7. How many hours, on average, each week do you spend watching programs/shows (on TV and/or over the internet)?

- Do not watch TV or programming over the internet
- Less than 1 hour
- 1-4 hours per week
- 5-12
- More than 12

8. How many hours, on average, each week do you spend watching detective /crime shows (such as CSI, Law and Order, NCIS, Forensic Files, Murder Detectives) on TV and/or over the internet?

- Do not watch TV or programming over the internet
- 1-4 hours per week
- 5-12
- More than 12

9. How close to reality do you believe these types of shows are?

- Not at all
- To some extent
- To large extent
- Don't know

Political ideology/ affiliation

10. Generally speaking, do you consider yourself to be a(n):

- o Strong Liberal
- o Moderate Liberal
- o Independent leaning Liberal
- o Independent
- o Independent leaning Conservative
- o Moderate Conservative
- o Strong Conservative
- o Other, Please specify_____
- o Don't know

11. Did your political ideology / affiliation have an influence on how much weight you put on the expert testimony you heard during this trial?

- o Not at all
- o To some extent
- o To large extent
- o Don't know

12. List in order of importance (6= least importance, 1= most importance) the most important qualifications of an expert witnesses

	University Education
	On the job training
	Certifications
	Years of experience
	Working in an accredited laboratory
	External training, such as conferences, workshops

13. With regard to (insert Expert witness name and brief description to the content of testimony) how credible (believable) was his/her testimony?

- o Not credible
- o Somewhat credible
- o Credible
- o Very credible

14. With regard to (Insert forensic science discipline, e.g. Firearms) testimony, how reliable do you believe the science of ballistics and bullet trajectory is?

- Not reliable
- Somewhat reliable
- Reliable
- Very reliable

15. Why do you believe the science of Ballistics is reliable /unreliable, Please explain

_____

_____

_____

_____

16. How effectively did the firearms examiner explain to you how he came to his conclusions?

- Poor Job
- Fair Job
- Good Job
- Great Job

17. Did the chart/ demonstration/ media presentation help you understand the subject matter (e.g. bullet trajectory?)

- Not at all
- To some extent
- To large extent

18. With regard (insert expert witness name and brief description to the content of testimony) how credible (believable) was his/her testimony?

- Not credible
- Somewhat credible
- Credible
- Very credible

19. With regard to (inert forensic science discipline, e.g. trace evidence), how reliable do you believe the science of locating trace evidence is?

- Not reliable
- Somewhat reliable
- Reliable
- Very reliable

20. Why do you believe the science of Trace evidence is reliable /unreliable, Please explain

_____

_____

_____

_____

21. How effectively did the trace examiner explain to you how she came to his/her conclusions?

- Poor Job
- Fair Job
- Good Job
- Great Job

22. With regard to (insert expert witness name and brief description to the content of testimony) how credible (believable) was his/her testimony?

- Not credible
- Somewhat credible
- Credible
- Very credible

23. With regard (Insert forensic science discipline, e.g. DNA), how reliable do you believe the science of Forensic DNA analysis is?

- Not reliable
- Somewhat reliable
- Reliable
- Very reliable

24. Why do you believe DNA is reliable /unreliable, Please explain

_____

_____

_____

_____

25. How effectively did the DNA examiner explain to you how she came to his/her conclusions?

- Poor Job
- Fair Job
- Good Job
- Great Job

26. Was it helpful to have other jurors to discuss the testimony of experts in this trial?

- Not helpful
- Somewhat helpful
- Helpful
- Very helpful

27. Did the other members of the Jury influence your decision on whether the expert testimony was reliable?

- Not at all
- To some extent
- To large extent

28. How important in your decision making was the expert witness Brandi Caron (trace examiner) who was called to testify by the State of Maine?

- Not at all
- To some extent
- To large extent

29. How important in your decision making was the expert witness Cathy MacMillan (DNA examiner) who was called to testify by the State of Maine?

- Not at all
- To some extent

30. How important in your decision making was the expert Richard Arnold (ballistics) who was called to testify by the defense counsel?

- Not at all
- To some extent
- To large extent

31. What was your greatest challenge in evaluating the scientific evidence presented? Please Explain-

_____

_____

_____

_____

_____

Follow-up

32. Would you be willing to participate in a follow up telephone or email conversation lasting approximately 15 minutes? After this conversation a small gratuity would be mailed to you to thank you for your time

- Yes, Please supply your name, your phone number and/ or email_____

  _____
- No, thank you

Appendix 5: Phone interview questions

Phone Interview questions for Jurors:

1. I would like to go back to one of the questions on the paper survey, the question stated list in order of importance the qualifications of an expert witness, University education, on the job training, certifications, years of experience, working in an accredited lab and external training such as conferences/workshops

2. Ask juror to confirm their order that they put on the paper survey

3. Define what an expert witness is then ask: What makes you think an expert witness is credible - demeanor, qualifications, experience?

4. Which is more important in an expert witness qualifications or experience and why?

5. What is the highest level of science education you have received? How long ago was that? Do you think your level of science knowledge impacted your understanding of the scientific information presented at the trial?

6. What in your opinion makes evidence reliable? What types of forensic evidence would be more reliable than others, could you give me an example?

7. What do you need to know to be able to evaluate the importance of a piece of evidence?

8. Are measurements taken with well-known tools like rulers as reliable as new technology? Which is better, more believable? Which would you have more confidence in?

9. Was there other information that would have been useful to know to help you decide if a piece of evidence was reliable or believable?

10. What did you think of how the lawyers dealt with the scientific evidence? Did they ask the questions you needed/wanted them to ask.

11. Did you feel that you didn't understand any of the scientific evidence and if so what would have helped?

12. What would you have asked the expert witness if you were allowed to ask questions?

13. What else did you think you needed to know to help you make your decision?

14. Which was more impactful, the scientific evidence or the other evidence in the case - police evidence, witness evidence?

15. Refer to survey to find out if the juror watches crime shows then ask: What is your opinion on how science is portrayed on crime shows? What parts are believable or unbelievable? (speed of analysis, certainty of result, credibility of witnesses and what makes a witness credible)

16. Refer to what they wrote for greatest challenge and as the juror to elaborate further What was challenging, in what way, what could have made it less challenging, if they were given background information on the science behind a technique for example would that have helped. What evidence did the feel was missing (fingerprints, DNA etc.) and why would this have been helpful. Expectations of additional testing?

17. What do you understand by the term unique, is there any type of forensic evidence that you think is more unique than others? (Fingerprints, DNA, toolmarks, ballistics etc.).